CHILD RESTRAINT SYSTEMS ON AIRCRAFT

(101-54)

HEARING

BEFORE THE

SUBCOMMITTEE ON AVIATION

OF THE

COMMITTEE ON
PUBLIC WORKS AND TRANSPORTATION
HOUSE OF REPRESENTATIVES

ONE HUNDRED FIRST CONGRESS

SECOND SESSION

ON

H.R. 4025

TO AMEND THE FEDERAL AVIATION ACT OF 1958 TO REQUIRE THE USE OF CHILD SAFETY RESTRAINT SYSTEMS APPROVED BY THE SECRETARY OF TRANSPORTATION ON COMMERCIAL AIRCRAFT

JULY 12, 1990

Printed for the use of the Committee on Public Works and Transportation

U.S. GOVERNMENT PRINTING OFFICE
34-982 WASHINGTON : 1991

For sale by the Superintendent of Documents, Congressional Sales Office
U.S. Government Printing Office, Washington, DC 20402

H641-3

COMMITTEE ON PUBLIC WORKS AND TRANSPORTATION

GLENN M. ANDERSON, California, *Chairman*

ROBERT A. ROE, New Jersey
NORMAN Y. MINETA, California
JAMES L. OBERSTAR, Minnesota
HENRY J. NOWAK, New York
NICK JOE RAHALL II, West Virginia
DOUGLAS APPLEGATE, Ohio
RON de LUGO, Virgin Islands
GUS SAVAGE, Illinois
DOUGLAS H. BOSCO, California
ROBERT A. BORSKI, Pennsylvania
JOE KOLTER, Pennsylvania
TIM VALENTINE, North Carolina
WILLIAM O. LIPINSKI, Illinois
PETER J. VISCLOSKY, Indiana
JAMES A. TRAFICANT, Jr., Ohio
JOHN LEWIS, Georgia
PETER A. DeFAZIO, Oregon
DAVID E. SKAGGS, Colorado
JIMMY HAYES, Louisiana
BOB CLEMENT, Tennessee
LEWIS F. PAYNE, Virginia
JERRY F. COSTELLO, Illinois
FRANK PALLONE, Jr., New Jersey
BEN JONES, Georgia
MIKE PARKER, Mississippi
GREG LAUGHLIN, Texas
PETER GEREN, Texas
GEORGE E. SANGMEISTER, Illinois
GARY L. ACKERMAN, New York
CARL C. PERKINS, Kentucky

JOHN PAUL HAMMERSCHMIDT, Arkansas
BUD SHUSTER, Pennsylvania
ARLAN STANGELAND, Minnesota
WILLIAM F. CLINGER, Jr., Pennsylvania
BOB McEWEN, Ohio
THOMAS E. PETRI, Wisconsin
RON PACKARD, California
SHERWOOD BOEHLERT, New York
JIM LIGHTFOOT, Iowa
DENNIS HASTERT, Illinois
JAMES M. INHOFE, Oklahoma
CASS BALLENGER, North Carolina
FRED UPTON, Michigan
BILL EMERSON, Missouri
BILL GRANT, Florida
LARRY E. CRAIG, Idaho
JOHN J. DUNCAN, Jr., Tennessee
MEL HANCOCK, Missouri
CHRISTOPHER COX, California
SUSAN MOLINARI, New York

Subcommittee on Aviation

JAMES L. OBERSTAR, Minnesota, *Chairman*

JOE KOLTER, Pennsylvania
RON de LUGO, Virgin Islands
PETER A. DeFAZIO, Oregon
JIMMY HAYES, Louisiana
GREG LAUGHLIN, Texas
NORMAN Y. MINETA, California
DOUGLAS H. BOSCO, California
TIM VALENTINE, North Carolina
WILLIAM O. LIPINSKI, Illinois
PETER J. VISCLOSKY, Indiana
JAMES A. TRAFICANT, Jr., Ohio
DAVID E. SKAGGS, Colorado
BOB CLEMENT, Tennessee
LEWIS F. PAYNE, Virginia
JERRY F. COSTELLO, Illinois
BEN JONES, Georgia
HENRY J. NOWAK, New York
JOHN LEWIS, Georgia
MIKE PARKER, Mississippi
PETER GEREN, Texas
GLENN M. ANDERSON, California
(Ex Officio)

WILLIAM F. CLINGER, Jr., Pennsylvania
BUD SHUSTER, Pennsylvania
ARLAN STANGELAND, Minnesota
BOB McEWEN, Ohio
THOMAS E. PETRI, Wisconsin
RON PACKARD, California
SHERWOOD BOEHLERT, New York
JIM LIGHTFOOT, Iowa
JAMES M. INHOFE, Oklahoma
CASS BALLENGER, North Carolina
JOHN J. DUNCAN, Jr., Tennessee
MEL HANCOCK, Missouri
SUSAN MOLINARI, New York
JOHN PAUL HAMMERSCHMIDT, Arkansas
(Ex Officio)

CONTENTS

Page
Summary of subject matter v
H.R. 4025: To amend the Federal Aviation Act of 1958 to require the use of child safety restraint systems approved by the Secretary of Transportation on commercial aircraft IX

TESTIMONY

Bianchi-Sand, Susan, president, Association of Flight Attendants, accompanied by Matthew Finucane, air safety and health director for Association of Flight Attendants, AFL-CIO 75
Bond, Hon. Christopher S., a Senator in Congress from Missouri 6
Broderick, Anthony J., Associate Administrator, Federal Aviation Administration 61
Brown, Jan, flight attendant, United Airlines Flight 232 75
Chandler, Richard F., retired, former manager, Protection and Survival Research Laboratory, FAA Civil Aeromedical Institute 98
Coleman, Walter S., vice president, Operations, Air Transport Association 75
Coughlin, Susan M. Vice Chairman, National Transportation Safety Board, accompanied by Nora Marshall, Senior Accident Investigator, Survival Factors Division 37
Cover, Adele, Fairfax, VA 98
Dresner, Martin E., assistant professor, College of Business and Management, University of Maryland 98
Kazman, Sam, general counsel, Competitive Enterprise Institute 98
Michaelson, Lori, passenger, United Airlines Flight 232, Sioux City 75
Witkowski, Christopher J., executive director, Aviation Consumer Action Project/Public Citizen 75

PREPARED STATEMENTS SUBMITTED BY MEMBERS OF CONGRESS

Bond, Hon. Christopher S., a Senator from Missouri 11
Clinger, Hon. William F., Jr., a Representative from Pennsylvania 4
Hammerschmidt, Hon. John Paul, a Representative from Arkansas 31
Lightfoot, Hon. Jim, a Representative from Iowa 19
McEwen, Hon. Bob, a Representative from Ohio 25
Packard, Hon. Ronald C., a Representative from California 35

PREPARED STATEMENTS OF WITNESSES

Bianchi-Sand, Susan 117
Broderick, Anthony J 125
Brown, Jan 284
Chandler, Richard F 290
Coleman, Walter S 295
Coughlin, Susan M 299
Cover, Adele 384
Michaelson, Lori R 386
Witkowski, Christopher J 391

SUBMISSIONS FOR THE RECORD

Broderick, Anthony J., Associate Administrator:
"Use of Child Restraints in Aircraft" 134
Paper: Children on British Air Carriers 74

Broderick, Anthony J., Associate Administrator—Continued
  Use of Child Restraints in Aircraft—Studies That Are Being Considered by the FAA in Making a Decision:
    1. Richard B. McKenzie and Dwight R. Lee, "Ending the Free Ride of Children on Airplanes: A Myopic Method of Saving Infants, Lives" Submitted to FAA Docket No. 26142 by the Competitive Enterprise Institute .... Page 135
    2. Richard B. McKenzie and John T. Warner, "The Impact of Airline Deregulation on Highway Safety" Submitted to FAA Docket No. 26142 by the Competitive Enterprise Institute 145
    3. Robert J. Windle and Martin E. Dresner, College of Business and Management, University of Maryland, "Mandatory Child Safety Seats in Air Transport: Do They Save Lives?" Submitted to FAA Docket No. 26142 by Drs. Windle and Dresner 188
    4. Apogee Research, Inc., "An Impact Analysis of Requiring Child Safety Seats in Air Transportation," Draft, June 4, 1990, Study conducted for the FAA under contract 210
Coleman, Walter S., vice president, Operations, Air Transport Association, letter supplementing testimony 96
Coughlin, Susan M., National Transportation Safety Board: Survivable Accidents in Which Children Received Injuries 309
Kazman, Sam, general counsel: "Issue of Mandatory Airline Child Seats" 310
Kolstat, James L., Chairman, National Transportation Safety Board:
  Safety Recommendations, letter 51
  Comments on the Apogee Research Report 58

ADDITIONS TO THE RECORD

Miller, Stuart R., testimony 398
Snyder, Richard G.:
  BioDynamics International, statement dated July 6, 1990 407
  Flight Safety Foundation, proceedings from October 31 to November 3, 1988 410
  Biography 432
  Resolution from Aerospace Medical Association 433

SUMMARY OF SUBJECT MATTER

The subject of the hearing is whether or not the Federal Aviation Administration should require children under age two to travel in safety seats aboard aircraft.

THE CURRENT SITUATION

Current Federal Aviation Administration regulations permit children under two to fly in the lap of an adult, rather than in separate child seats. The airlines presently permit lap-held children to fly free. Most child car seats are approved for airline travel, and some parents opt to use them. However, not all airlines accept them on board. Children 2 years and older must fly in separate seats. The FAA's Civil Aeromedical Institute (CAMI) has found that adult seat belts adequately restrain children two years of age and older, but that they are not suitable for younger children whose bodies are not strong enough to resist increased pressures.

BACKGROUND

FAA has conducted research on infant/child restraints since the early 1960s, primary at CAMI. The National Transportation Safety Board has over the years urged a more active posture by FAA. FAA has responded by strengthening the specifications for child restraints, and has increased its encouragement of their use, but has not made them mandatory.

The Sioux City, Iowa crash of United Airlines flight 232, on July 19, 1989, brought the issue to the forefront. Among the 285 passengers on board were 3 infants and 1 small child, ranging in age from 11 to 26 months, who were being held by adults. One infant was torn from his mother's arms during the impact, and died of asphyxia secondary to smoke inhalation. The other two infants and the small child sustained minor injuries. One of the surviving infants was also separated from her mother on impact, but rescued by another passenger.

On February 20, 1990, Mr. Lightfoot introduced H.R. 4025, to require the use of child safety restraint systems approved by the Department of Transportation on all commercial aircraft.

The Air Transport Association (ATA), the Aviation Consumer Action Project (ACAP) and the Los Angeles Area Child Passenger Safety Association have formally petitioned the FAA to initiate rulemaking to require mandatory restraints for infants under two years old.

On March 1, 1990, the FAA issued a Notice of Proposed Rulemaking (NPRM) requiring air carriers to accept approved child restraint systems provided by a parent or guardian. While strongly advocating the use of such restraints, the FAA declined to make such use mandatory. Comment period on the NPRM closed on May 30.

On May 30, 1990, the National Transportation Safety Board, following its investigation into the Sioux City crash, recommended to the FAA that all occupants, including infants under 2, be restrained during takeoff, landing, and turbulent conditions, and that all infants and small children below the weight of 40 pounds and under the height of 40 inches be restrained in an approved child restraint system appropriate to their height and weight.

THE ISSUES

Child seats in cars have indisputably saved lives and reduced injuries. There is little argument that child restraints on aircraft would also save lives of tiny passengers in the event of a crash. The debate centers rather on whether such restraints should be mandatory.

FAA has identified 8 commercial airlines accidents over the last 15 years, involving infants and children in which the proper use of child safety seats may have reduced casualties.

Arguments for mandatory restraints:

Supporters argue first that under the current system equal protection is not provided to all air travelers; in fact, the only persons (and other items) in the cabin not fully secured during take-off and landing are infants under 2. Further underlining the inequities, as the ATA points out, "If we buckle up children at 50 miles an hour, why not at 550 miles per hour?"

G forces in a crash are too great for a parent to safely hold a child—as demonstrated by the Sioux City tragedy; a child on a lap may be crushed by the weight of the parent, and children held on the floor, as in the Sioux City crash, can be torn from their parents' grasp.

NTSB investigations have repeatedly shown problems with the safety and survivability of unrestrained infants and small children involved in survivable crashes and turbulence. The Board is presently investigating two more accidents involving the safety and survivability of small children.

Some carriers permit the use of restraints, others do not, creating confusion for parents and difficulties in inter-carrier travel. There is also confusion among air carrier personnel over whether seats can be used. Mandating child restraints would clarify the situation for all, and assure protection of all passengers, including the very youngest.

Arguments against mandatory restraints

Some opponents argue that a mandatory requirement would place an unwarranted restriction on consumer choice. Others argue that the cost to the family would simply be too great.

Regarding economic impact, the FAA estimates that 4 million children two years old or less fly each year. Assuming that airlines would charge at least some amount of money for the seat occupied by the child and restraint, the agency further calculates that the extra seat for an infant would cost an average of $62.15 per enplanement, or about $212 million annually to consumers, and that some 700,000 families would opt not to fly—either to forego the trip, or to go by car. In view of the total cost of a mandatory requirement, FAA has declined to propose this at this time, but does invite comments on the desirability of such a requirement.

Would mandatory restraints save lives? Some argue that the few air passengers lives expected to be saved do not justify the costs to society. However, a second level of criticism focuses on total lives saved. Some statistical studies indicate that the additional air fares would force at least some families off the airlines and onto highways, where the danger is manifestly greater, thus increasing the total number of casualties, children as well as adults.

If made mandatory, who should provide the child restraint seats? Child restraints must be certified and approved for use on aircraft. Most car seats today are so certified.

A related question is whether, if child restraints are made mandatory, the airline should be required to provide them, whether parents should be required to rent them or carry them through the airports along with the child and the attendant baggage. FAA in its NPRM decided against requiring airlines to provide the child restraint seats.

I

101st CONGRESS
2d Session

H. R. 4025

To amend the Federal Aviation Act of 1958 to require the use of child safety restraint systems approved by the Secretary of Transportation on commercial aircraft.

IN THE HOUSE OF REPRESENTATIVES

February 20, 1990

Mr. Lightfoot (for himself, Mr. Roe, Mrs. Bentley, Mr. Lancaster, Mr. de Lugo, Mr. Fauntroy, Mr. Shays, Mr. Smith of New Jersey, Mr. Fuster, Mr. Foglietta, Mr. Towns, and Mr. English) introduced the following bill; which was referred to the Committee on Public Works and Transportation

---

A BILL

To amend the Federal Aviation Act of 1958 to require the use of child safety restraint systems approved by the Secretary of Transportation on commercial aircraft.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. CHILD RESTRAINT SYSTEMS ON COMMERCIAL AIRCRAFT.

(a) In General.—Section 601 of the Federal Aviation Act of 1958 (49 U.S.C. App. 1421) is amended by adding at the end the following new subsection:

X

"(g) Child Restraint Systems.—Not later than 90 days after the date of the enactment of this subsection, the Secretary shall issue regulations requiring the use of child safety restraint systems approved by the Secretary on aircraft providing air transportation of passengers. Such regulations shall establish age or weight limits for children who are to use systems.".

(b) Conforming Amendment.—The table of contents contained in the first section of such Act is amended by inserting at the end of the matter relating to section 601 the following new item:

"(g) Child restraint systems.".

CHILD RESTRAINT SYSTEMS ON AIRCRAFT

THURSDAY, JULY 12, 1990

House of Representatives,
Subcommittee on Aviation,
Committee on Public Works and Transportation,
Washington, DC.

The subcommittee met, pursuant to notice, at 1:12 p.m. in room 2167, Rayburn House Office Building, Hon. James L. Oberstar (chairman of the subcommittee) presiding.

Mr. **Oberstar**. The Subcommittee on Aviation will please come to order.

This afternoon we meet to take testimony on H.R. 4025, which would require the Federal Aviation Administration to mandate child restraints for air passengers under two years of age, and on other proposals dealing with the same subject, legislation introduced by our colleague from Iowa, Mr. Lightfoot, who has been very much of a champion on this issue. The principal reason we are holding this hearing today is that his advocacy on the issue has been a very effective one.

Seat belts and child seats in cars are now accepted practice, and they are mandated in all 50 States and the District of Columbia, but such protection is not required for the youngest of our airline passengers. In fact, all passengers and all other articles aboard an aircraft, by regulation, must be tightly secured on both takeoff and landing, and during turbulent conditions in the air, except children under the age of two.

The need for securing these very young, one might even say in certain cases, tiny, passengers is very dramatically and tragically demonstrated in the Sioux City, Iowa, crash of United Airlines flight 232 on July 19, 1989. Among the 285 passengers on board were three infants and one small child, ranging in age from 11 to 26 months. They were being held by adults. One infant was torn from his mother's arms on impact and died of asphyxia, which was secondary to smoke inhalation. The other two infants and the small child sustained minor injuries. One of the surviving infants was also separated from her mother on impact, but rescued by another passenger. The National Transportation Safety Board in the wake of that accident recommended the FAA require all children to be secured in child restraint seats. The evidence certainly is incontrovertible. Even the youngest passengers are safest when they are in their restraints, not held by another. The immediate and logical reaction therefore is to support mandatory child restraints. We certainly will hear much testimony in that direction in the course of our hearings this afternoon.

We are also going to hear other testimony opposing that requirement. It is going to be very thoughtful and well crafted testimony. It is not going to come from those who have vested interest or from people who simply are unconcerned or less concerned with the safety of these young passengers, but from reasoned, thoughtful, and caring people and that gives me pause.

Opponents of mandatory restraints include the Federal Aviation Administration. Last Spring, FAA issued a notice of proposed rulemaking that would require airlines to accept child seats, but then they stopped short of requiring that those seats be used. That was not taken lightly.

Opponents might include also a very large number of American parents, who under state law must have car seats for their children, but who may vote in another way by not bringing those very same seats aboard aircraft. Admittedly there is much confusion. There is inconsistency surrounding the use of child seats on aircraft. For whatever reason the use has remained at very low levels for the past several years.

Children under two now fly free, when they are seated on their parents laps. Child seats, the restraint seats, actually have to take up a seat of their own and they require an extra ticket. The airlines have every interest in keeping families with young children as passengers. They also are not likely to make very many adjustments. They are also not likely to charge full fares for the extra ticket. Nonetheless parents will end up buying a ticket for a child who used to fly free, if they choose to put that child aboard in a child restraint seat and secure its safety aboard that aircraft.

The FAA has identified eight accidents over the past 15 years in which infants, if properly restrained, would have survived. There are few firm known numbers, but the FAA has calculated that the cost to passengers of mandatory child restraints would be $62.15—I don't know where they got the 15 cents, but that's what they came up with—per enplanement for a total of some $212 million per year. Some people therefore claim that the risk doesn't justify the cost.

Further, the FAA estimates that several hundred thousand families would decide, based on increased costs, not to fly. We will have to see where that figure came from. Other passengers might, because of the increased cost, choose not to fly, not to make that trip to see their grandparents or friends or family, at a long distance. Or, in the case of our family, Grandma would have to come to the grandchildren. Some families would opt to travel by car. That would be manifestly less safe than flying by air.

Studies that we are going to hear about today have indicated that diverting passengers from aircraft to automobiles will result in more fatalities overall. That creates another kind of dilemma for policy-makers in trying to save lives on board aircraft. Do we only endanger more lives on the roadways?

Those are the dilemmas before the committee. Perhaps there will be others. That is the job of hearings: To get the facts, lay it all out on the table, sort it out, try to think it through. This committee is accustomed to doing that. We have some members of this committee who are extraordinarily thoughtful and perceptive. In the course of this hearing process we are going to think those issues through and afterward we will be further deliberating on them.

The issue itself is of such great significance that it is one that we should try to deal with in the course of this session of Congress.

I recognize the gentleman from Pennsylvania, Mr. Clinger.

Mr. CLINGER. Thank you very much, Mr. Chairman.

As you have already indicated, the use of child safety restraints on board commercial aircraft poses a number of very interesting questions and challenges, also a number of potential benefits that could arise out of the mandating of these restraints.

All passengers on board aircraft should be entitled, clearly, to full safety restraints regardless of body size. Infants traveling on parents' laps typically do not enjoy such a level of safety. As the testimony that we are going to hear today will point out, several avoidable deaths have occurred as a result.

Requiring the use of child safety seats certainly will enhance the infant's safety during flight, but if setting aside a separate seat to accommodate a child also requires the parent or guardian to purchase the seat, a number of implications arise which I think we need to explore today.

A family with young children may find that flying is too expensive an option, and instead use alternative and, as you have indicated, riskier forms of transportation. Carriers may establish pricing schemes to induce parents traveling with paying children to fly off peak hours.

Is the family expected to provide their own child restraint seats? Should child restraint seats meet certain performance guidelines or design criteria to accommodate all styles of airline seats? If carriers provide child restraint seats, how difficult and what expense will it incur to keep an adequate number of child restraint seats in stock at all airports? There are a number of these kinds of issues that I think need to be addressed and will be today.

I certainly want to join with you in commending our esteemed colleague, Representative Lightfoot, who has taken such an active role in promoting this issue. I think his leadership has been very critical and instrumental in arranging for today's hearings. I want to thank today's witnesses, welcome Senator Bond and others who will be testifying before us today. I look forward to what should be a very interesting and long hearing.

[Mr. Clinger's prepared statement follows:]

Opening Statement of
The Honorable William F. Clinger, Jr.
During the Aviation Subcommittee Hearing on
Child Safety-Restraints

Mr. Chairman, the use of child safety restraints on board commercial aircraft poses a number of interesting questions and benefits.

All passengers on board aircraft should be entitled to full safety restraints, regardless of age or body size. Infants traveling on parents' laps typically do not enjoy such a level of safety, and as testimony will point out, several avoidable deaths have occurred as a result.

Requiring the use of child safety seats certainly will enhance the infant's safety during flight. But if setting aside a separate seat to accommodate a child also requires the parent or guardian to purchase the seat, a number of implications arise.

A family with young children may find that flying is too expensive an option and instead use alternative and riskier forms of transportation. Carriers may establish pricing schemes to induce parents traveling with paying children to fly off-peak hours.

Is the family expected to provide their own child restraint seats? Should child restraint seats meet certain performance guidelines or design criteria to accommodate all styles of airline seats? If carriers provide child restraint seats, how difficult -- and at what expense -- will it be to keep an adequate number of child restraint seats in stock at all airports? These and a number of other policies need to be addressed.

I commend our colleague, Rep. Lightfoot, for taking such an active role in this issue. His leadership has been instrumental in arranging for today's hearing.

I, too, want to thank today's witnesses for taking time from their busy schedules to appear before our Subcommittee this afternoon. I look forward to their testimony.

Thank you, Mr. Chairman.

Mr. Oberstar. The Chair would like to make an inquiry of our colleagues on the committee in light of some unusual circumstances. We have a recorded vote in progress and the Senator has a requirement to be in the other body at 1:45 p.m. Would other members yield for the moment their opening remarks so that we can take the testimony of the Senator, make this vote, then come back and take other opening statements? It is a matter of accommodating our colleague in the other body.

Since there is no objection, Senator, please begin. Welcome to our hearing. We respect your great interest in and support of this issue of safety aboard aircraft.

TESTIMONY OF HON. CHRISTOPHER S. BOND, U.S. SENATOR FROM THE STATE OF MISSOURI

Senator Bond. Thank you, Mr. Chairman and members of the subcommittee. I am Christopher S. Bond, and I am testifying today in support of H.R. 4025, legislation introduced by Congressman Lightfoot and others which would require the use of child safety restraint seats for infants. We have a companion bill in the Senate which was introduced by Senator Danforth and myself, S. 1913.

I very much appreciate you accommodating me and I commend you and the ranking member on the obvious amount of forethought and consideration that you have given this matter prior to the hearing.

Like Congressman Lightfoot, I have a deep personal interest in this issue. Approximately nine years ago, my wife and I were blessed to have a son. We knew from our pediatrician that he should never travel in an automobile without a safety seat. We traveled with him everyplace we went that we possibly could in a safety seat. We flew on general aviation aircraft and he was in a safety seat. But when we tried to fly with him on commercial aircraft, we always purchased a seat for him, took along the safety seat and under FAA regulations, which are the same now as they were then, each airline had the opportunity to establish its own policy.

The result was totally inconsistent and different policies. Some airlines said that we had to stow the safety seat as luggage. The only airlines that let us take the safety seat on the airplane required us to take the child out of the seat on takeoff and landing and let him sit only in the safety seat during the safe part of the flight.

Now, needless to say, that caused me no small concern. I happened to be Governor of Missouri at the time. I spent four fruitless years writing and petitioning and begging the FAA to do something about it. Now, finally, a little bit late, I understand the FAA has proposed an amendment to the current rule which would require airlines to allow the use of an approved safety seat, if one is provided by the parents. The comment period closed on May 30; the FAA has not indicated when it will issue a final rule.

Mr. Chairman, while I applaud the FAA for this belated effort to improve the current rule, it does not go far enough, it does not go fast enough. In my view, nothing short of a mandatory rule will suffice in protecting our smallest travelers. There is a great deal of support for a mandatory rule—it is now endorsed by the Air Transport Association, the Association of Flight Attendants and just recently, the National Transportation Safety Board. The NTSB unanimously approved a recommendation to the FAA urging the agency to make the use of safety sets mandatory. This was welcome news—and we hope that the FAA will give favorable consideration to the board's recommendation and adopt it as its final rule.

But hoping for action is not enough. The NTSB recommendation is just that—a recommendation. The board does not have rulemaking authority, it must wait for the FAA's acceptance or rejection. Frankly, based on my experience with the FAA, I am not particularly encouraged or enthusiastic about the prospects for that. I think that Congress can and should direct the FAA to take action and that is why I am testifying in support of this legislation today.

The arguments for this legislation are, I believe, straightforward and compelling.

First and foremost, a discretionary policy leaves infants' lives at risk. If a child is under two years old, a parent can choose to hold him in his or her lap. However, the force of a crash or severe turbulence completely overwhelms the parent's ability to restrain the child. You, yourself, Mr. Chairman, have referred to the Sioux City crash. I would point out that the Avianca Flight 52 crash in New York is one in which one child under 12 was killed and six others injured, of the seventeen on board. Why do we require restraints for an infant's family—his parents and brothers and sisters—but not for him? Why are airlines required to tie down and secure every single item in the cabin before takeoff—luggage, liquor, food and blankets, and even corpses—but not babies? Why do we require everything and everyone to be restrained—except for the most vulnerable of all, children under two? It is clear to me that the only way to guarantee that the most helpless group of travelers is protected is through a mandatory set rule.

Second, as discussed earlier, the current policy varies from airline to airline, flight to flight and even sometimes from airline employee to airline employee. It is confusing, vague and frustrating. The only way to clear up this confusion is through a mandatory restraint policy, which leaves no room for misinterpretation.

I realize that there is concern about the costs of a mandatory policy because families may have to buy a ticket for the toddler or the infant instead of flying with her free of charge. I can share this concern, but legislation leaves the decision on fares up to the airlines. There are several ways that the airlines can keep fares reasonable and we believe that they will do so in order to maintain their customer base. It is in their own profit oriented interest to do so. For example, many carriers currently allow parents to use a vacant seat free of charge, during off peak travel periods. Many airlines currently offer discounted fares for children over two—they could simply modify those fares to include infants and toddlers.

Fortunately, parents are unlikely to have to purchase an additional infant seat for air travel. Most auto safety seats manufactured since 1985 have already been approved by the FAA for use on airplanes. As you have pointed out, Mr. Chairman, state laws in all states, and I happened to recommend and signed into law that particular provision in Missouri, require that infants traveling to an airport in a car have to be restrained in the safety seat.

Now, I understand that the FAA will finally release its long awaited costs-benefit analysis of a mandatory set rule. My staff has been trying to get a copy of that for quite a while. I am disturbed and disappointed that it is being released only on the day of the hearing. It would have been helpful for us to review it, but since I have not seen it I can only comment on the conclusions as outlined in the report summary. Essentially, the study concludes that the cost of an extra ticket for children under two will cause families to drive instead of fly. As a result, it says, more children will die in auto accidents, because they occur more often than airplane accidents. Mr. Chairman, I find that reasoning appalling.

First, a lower rate of injury and death for children from aviation accidents means that adult injuries are also lower. Does this mean that adults should not be required to use seat belts on airplanes? If this line of argument were carried to its logical extreme, and I think logical extreme in that case is an oxymoron, we wouldn't require oxygen masks, flame retardant seats or safety lights on airplanes. In fact we could allow the airlines to sell standing-room-only tickets. Think of how many people that would take off the highways and how many lives that would save. This is just as ridiculous as their opposition to a mandatory seat belt rule.

Sure, safety does have a cost. I submit that the lack of safety carries the highest cost of all, the loss of life.

Mr. OBERSTAR. Senator, I regret that I have 30 seconds to make the vote on the House floor. One of my colleagues will return. We will have to recess momentarily.

Senator BOND. I understand and I very much appreciate your accommodation.

Mr. OBERSTAR. You make a very forceful statement. I will be back shortly.

[Recess.]

Mr. LAUGHLIN [assuming chair]. We have half the team back. In absence of the Chairman, I will tell you, it's the most important part of the team. I can get away with that, being a freshman.

Senator BOND. Mr. Chairman, does that appear in the record of the meeting, or should we strike that out before it is recorded?

Mr. LAUGHLIN. I am from Texas, so we will keep it in the record.

Senator BOND. Alright, sir. I had made a long and extensive argument, which I will submit for the record. I will just close by repeating what I just said about the conclusion of the study that I hope will be presented today. I have not seen it yet. We understand that the cost of an extra ticket for children under two will cause more families to drive instead of fly. As a result, more children will die in auto accidents. I just find that reasoning totally unacceptable and absolutely ridiculous. If we follow that same reasoning then we would encourage everybody to get on an airplane whether they had a safety belt or not. We would sell standing room tickets on airplanes because all of those people, under the FAA rules, would be much safer than if they traveled by bus or by car. If you don't let the adults travel standing up in the aisles, why should you make children ride on their parents' laps when they are just as vulnerable, perhaps more so, than an unrestrained adult, who at least has some means of protecting himself in a crash.

I had noted earlier that it is in the airlines best interest to keep families flying. In order to do so, I think that they will establish fares for infants that are reasonable and they will work to accommodate the needs of families. Traveling with children is expensive to begin with and I would not advocate increasing that burden without a very good cause. I believe that protecting their lives is, indeed, a good reason. If infants seats are not required, we will continue to treat our children as second-class citizens. I do not think we can deny our smallest children the same protection we give ourselves. I thank you.

Mr. LAUGHLIN. Thank you, Senator Bond. Looking at the clock, I see you have a few moments left before you have to depart.

Next, I will turn to the ranking Republican, the gentleman from Pennsylvania, for any questions.

Mr. CLINGER. Thank you very much. I have no questions.

I think you make a very persuasive case for the child passenger restraint. I think it is a little attenuated to say that we would be encouraging everybody to go in automobiles, and therefore we shouldn't do that because somehow it would result in more deaths. That really does seem to me to be a little bit specious argument. I appreciate very much your testimony here. I am glad that you could be with us.

Senator BOND. Thank you, sir.

Mr. LAUGHLIN. Next, I turn to my good friend, the ranking Republican from Iowa, on this committee.

Mr. LIGHTFOOT. Thank you, Mr. Chairman. Senator, we will try and get you out of here so you can make your vote. I only have a couple of real quick questions. Since both you and I are Republicans this is somewhat of an unusual role for Republicans to be in, mandating some kind of a requirement that people have to live up to. I'm sure you heard that criticism as well. What is your response to it?

Senator BOND. Well, Congressman, I believe in government regulations where they are clearly shown to be necessary, where the benefits clearly outweigh the risks. I heard some of those criticisms when I recommended a mandatory auto safety restraint bill as governor, one I worked hard to get passed and I signed into law. I think that the courts have consistently held that a state has an obligation to protect minors when there is a demonstrated risk from which they cannot protect themselves. I think in this situation we have a classic example. We are doing through needed and justified government regulations what the children, the infants and toddlers, cannot do to protect themselves.

Mr. LIGHTFOOT. You've introduced a companion measure over on the Senate side. Basically, we announced both of these together on the same day. We have also sent a letter to the FAA on their proposed rule-making. Where does the companion measure sit at this point in the Senate?

Senator BOND. Congressman, we were successful in adding it as an amendment on the floor to the Blind Airline Passengers Bill. It was accepted. Unfortunately, due to other controversies surrounding that measure, the bill has been withdrawn. We are seeking a hearing or a discharge of the bill from the Senate Commerce Committee. Senator Danforth is a co-sponsor of that measure. We hope that the committee will act and the full Senate will soon have an opportunity to act on S. 1913.

Mr. LIGHTFOOT. In the industry, we are using the age two as a cut-off, because that is a current standard. NTSB has come out with a recommendation on 40 pounds and 40 inches. Personally, I have no problem with letting the safety experts determine what that requirement should be. Does that coincide with your thinking?

Senator BOND. Yes, it does, sir. I think that in our S. 1913 we say that the regulation shall establish age or weight limits for children who are to use the system. Frankly, in most states, four is generally the age. Now, the safety experts may say that once you reach 40 inches or 40 pounds, then you are adequately protected by a seat belt, but it may make sense for them to pass a regulation based on the size of the infant. That is left to the discretion of the experts. There are obviously a number of different means of achieving the appropriate restraint. That, too, would be left to the discretion of the safety agency.

Mr. LAUGHLIN. I know you are on a short string. Being your neighbor in Iowa, just across the line from Missouri, we are not going to hold you up and make you late for the vote. I really appreciate your help on the Senate on this particular issue and appreciate your coming over and being a part of the hearing today.

Senator BOND. Thank you, Congressman, I appreciate your leadership and all the information you have given us and the help that you have provided us on the Senate side.

Mr. LAUGHLIN. Senator Bond, on behalf of the committee, I thank you for taking the time to appear before us. I deeply appreciate your comments and your observations and the leadership you are going to give this committee.

Senator BOND. Mr. Chairman, I appreciate very much the kindness and hospitality you have shown us. This has been an oasis in a day of chaos on the other side. It is a pleasure to be with you and your colleagues.

Mr. LAUGHLIN. You are welcome back to this side anytime. Thank you.

[Senator Bond's prepared statement follows:]

STATEMENT BY SENATOR CHRISTOPHER S. BOND ON H.R. 4025, LEGISLATION REQUIRING THE USE OF CHILD RESTRAINT SYSTEMS ON COMMERCIAL AIRCRAFT

HOUSE COMMITTEE ON PUBLIC WORKS AND TRANSPORTATION
SUBCOMMITTEE ON AVIATION

THURSDAY JULY 12, 1990

THANK YOU, MR. CHAIRMAN AND MEMBERS OF THE SUBCOMMITTEE. I AM TESTIFYING TODAY IN SUPPORT OF H.R. 4025, LEGISLATION INTRODUCED BY CONGRESSMAN LIGHTFOOT AND OTHERS WHICH WOULD REQUIRE THE USE OF CHILD SAFETY SEATS ON AIRLINES FOR CHILDREN UNDER THE AGE OF TWO. SENATOR DANFORTH AND I ARE THE COSPONSORS OF S. 1913, THE COMPANION SENATE BILL.

LIKE CONGRESSMAN LIGHTFOOT, I HAVE A DEEP PERSONAL INTEREST IN THIS ISSUE. NINE YEARS AGO, WHEN MY SON SAM WAS BORN, MY WIFE AND I WOULD TAKE HIM WITH US AS OFTEN AS WE COULD WHEN WE TRAVELLED. WHEN WE FLEW, WE WOULD ALWAYS TAKE HIS SAFETY SEAT FROM THE CAR TO USE ON THE PLANE. THEN, AS NOW, FAA POLICY GIVES AIRLINES THE DISCRETION TO ALLOW OR PROHIBIT THE USE OF CHILD SAFETY SEATS. WE QUICKLY DISCOVERED THAT EACH AIRLINE HAS A DIFFERENT--AND CONFUSING--INTERPRETATION OF THE FAA POLICY.

SOME AIRLINES WOULDN'T ALLOW US TO USE THE CAR SEAT AT ALL-EVEN WHEN WE HAD ALREADY PURCHASED A TICKET FOR OUR SON. THEY INSISTED THAT HE SIT IN OUR LAPS, A PRACTICE WE FELT WAS VERY UNSAFE. OTHER

AIRLINES WOULD ALLOW US TO USE THE SEAT DURING FLIGHT BUT NOT DURING TAKEOFF AND LANDING, WHICH ARE THE MOST POTENTIALLY DANGEROUS PERIODS OF A FLIGHT.

THE FAA HAS PROPOSED AN AMENDMENT TO THE CURRENT RULE WHICH WOULD REQUIRE AIRLINES TO ALLOW THE USE OF AN APPROVED SAFETY SEAT IF PROVIDED BY THE PARENTS. THE COMMENT PERIOD CLOSED ON MAY 30; THE FAA HAS NOT INDICATED WHEN IT WILL ISSUE A FINAL RULE.

MR. PRESIDENT, WHILE I APPLAUD THE FAA FOR THIS EFFORT TO IMPROVE THE CURRENT RULE, IT DOES NOT GO FAR ENOUGH, FAST ENOUGH. IN MY VIEW, NOTHING SHORT OF A MANDATORY RULE WILL SUFFICE IN PROTECTING OUR SMALLEST TRAVELERS. THERE IS A GREAT DEAL OF SUPPORT FOR A MANDATORY RULE--IT IS ENDORSED BY THE AIR TRANSPORT ASSOCIATION, THE ASSOCIATION OF FLIGHT ATTENDANTS AND JUST RECENTLY, THE NATIONAL TRANSPORTATION SAFETY BOARD. THE NTSB UNANIMOUSLY APPROVED A RECOMMENDATION TO THE FAA URGING THE AGENCY TO MAKE THE USE OF SAFETY SEATS MANDATORY. THIS WAS WELCOME NEWS--AND WE HOPE THAT THE FAA WILL GIVE FAVORABLE CONSIDERATION TO THE BOARD'S RECOMMENDATION AND ADOPT IT AS ITS FINAL RULE.

BUT HOPING FOR ACTION IS NOT ENOUGH. THE NTSB RECOMMENDATION IS JUST THAT--A RECOMMENDATION. THE BOARD DOES NOT HAVE RULEMAKING AUTHORITY--IT MUST WAIT FOR THE FAA'S ACCEPTANCE OR REJECTION. CONGRESS CAN AND SHOULD DIRECT THE FAA TO TAKE ACTION AND THAT IS WHY I AM TESTIFYING TODAY IN SUPPORT OF H.R. 4025.

THE ARGUMENTS FOR THIS LEGISLATION ARE COMPELLING AND STRAIGHTFORWARD.

FIRST AND FOREMOST, THE CURRENT DISCRETIONARY POLICY LEAVES INFANTS LIVES AT RISK. IF A CHILD IS UNDER TWO YEARS OLD, A PARENT CAN CHOSE TO HOLD HIM IN HIS OR HER LAP. HOWEVER, THE FORCE OF A CRASH OR SEVERE TURBULENCE COMPLETELY OVERWHELMS THE PARENT'S ABILITY TO RESTRAIN THE CHILD. THIS WAS GRAPHICALLY ILLUSTRATED BY THE UNITED AIRLINES CRASH IN SIOUX CITY LAST SUMMER, WHERE TWO UNRESTRAINED INFANTS WERE AMONG THE VICTIMS. ANOTHER INFANT MIRACULOUSLY SURVIVED BECAUSE SHE WAS PROPELLED INTO AN OVERHEAD LUGGAGE COMPARTMENT. WHY DO WE REQUIRE RESTRAINTS FOR AN INFANT'S FAMILY--HIS PARENTS AND BROTHERS AND SISTERS--BUT NOT FOR HIM? WHY ARE AIRLINES REQUIRED TO TIE DOWN AND SECURE EVERY SINGLE ITEM IN THE CABIN BEFORE TAKEOFF--LUGGAGE, LIQUOR, FOOD AND BLANKETS--BUT NOT BABIES? WHY DO WE REQUIRE EVERYTHING AND EVERYONE TO BE RESTRAINED--EXCEPT FOR CHILDREN UNDER TWO YEARS OLD? IT IS CLEAR TO ME THAT THE ONLY WAY TO GUARANTEE THAT THE MOST HELPLESS GROUP OF TRAVELERS IS PROTECTED IS THROUGH A MANDATORY SEAT RULE.

SECONDLY AND AS I DISCUSSED EARLIER, THE CURRENT POLICY VARI FROM AIRLINE TO AIRLINE, FLIGHT TO FLIGHT AND AIRLINE EMPLOYEE TO AIRLINE EMPLOYEE. IT IS CONFUSING, VAGUE AND FRUSTRATING. THE ONLY WAY TO CLEAR UP THIS CONFUSION IS THROUGH A MANDATORY SEAT POLICY, WHICH LEAVES NO ROOM FOR MISINTERPRETATION.

I REALIZE THAT THERE IS CONCERN ABOUT THE COSTS OF A MANDATORY POLICY BECAUSE FAMILIES MAY HAVE TO BUY A TICKET FOR THEIR TODDLER INSTEAD FLYING HIM FREE OF CHARGE. I UNDERSTAND THIS CONCERN. OUR LEGISLATION LEAVES THE DECISION ON FARES UP TO THE AIRLINES. THERE ARE SEVERAL WAYS THAT THE AIRLINES CAN KEEP FARES REASONABLE AND WE BELIEVE THAT THEY WILL DO SO IN ORDER TO MAINTAIN THEIR CUSTOMER BASE. FOR EXAMPLE, MANY CARRIERS CURRENTLY ALLOW PARENTS TO USE A VACANT SEAT FREE OF CHARGE, PARTICULARLY DURING OFF PEAK TRAVEL PERIODS. MANY AIRLINES CURRENTLY OFFER DISCOUNTED FARES FOR CHILDREN OVER TWO--THEY COULD SIMPLY MODIFY THEM TO INCLUDE INFANTS AND TODDLERS.

FORTUNATELY, PARENTS ARE UNLIKELY TO HAVE TO PURCHASE AN ADDITIONAL INFANT SEAT FOR AIR TRAVEL. MOST AUTO SAFETY SEATS MANUFACTURED SINCE 1985 HAVE ALREADY BEEN APPROVED BY THE FAA FOR USE ON AIRPLANES. PARENTS SIMPLY HAVE TO TAKE THE SEAT FROM THE CAR TO THE PLANE.

MR. CHAIRMAN, I UNDERSTAND THAT THE FAA WILL RELEASE ITS LONG AWAITED COST-BENEFIT ANALYSIS OF A MANDATORY SEAT POLICY TODAY. WE'VE BEEN TRYING TO SEE THAT STUDY FOR QUITE A WHILE AND I FIND IT VERY DISTURBING THAT IT IS FINALLY BEING MADE PUBLIC THE DAY OF THIS HEARING. IT WOULD HAVE BEEN USEFUL TO REVIEW IT BEFORE THE HEARING. SINCE I HAVE NOT HAD THE OPPORTUNITY TO REVIEW IT, I CAN ONLY COMMENT ON ITS CONCLUSIONS AS OUTLINED IN THE SUMMARY OF THE ANALYSIS. ESSENTIALLY, THE STUDY CONCLUDES THAT THE COST OF AN EXTRA TICKET FOR CHILDREN UNDER TWO WILL CAUSE FAMILIES TO DRIVE

INSTEAD OF FLY AND THAT AS A RESULT, MORE CHILDREN WILL DIE IN AUTO ACCIDENTS. I DISAGREE WITH THIS CONCLUSION. FIRST, AS I NOTED EARLIER, IT IS IN THE AIRLINES ECONOMIC INTEREST TO KEEP FAMILIES FLYING. AND IN ORDER TO DO SO, I BELIEVE THAT THEY WILL ESTABLISH FARES FOR INFANTS THAT ARE REASONABLE. SECOND, THE SUMMARY DOES NOT ADDRESS THE FACT THAT UNDER THE CURRENT INFANT SEAT POLICY, CHILDREN UNDER TWO ARE AT RISK OF INJURY AND DEATH. IT IS TRUE THAT AVIATION ACCIDENTS OCCUR LESS OFTEN THAN AUTO ACCIDENTS. HOWEVER, WHEN AIRLINE ACCIDENTS HAPPEN, BABIES AND TODDLERS HAVE THE LOWEST CHANCES FOR SURVIVAL BECAUSE THEY ARE THE LEAST PROTECTED. FINALLY, IF THIS LINE OF ARGUMENT WERE CARRIED TO ITS ULTIMATE CONCLUSION, WE WOULDN'T REQUIRE SEAT BELTS AND OXYGEN MASKS FOR ANY AIRLINE PASSENGER. IN FACT, WE COULD ALLOW THE AIRLINES TO SELL STANDING ROOM TICKETS! THE FACT IS, SAFETY HAS A COST. HOWEVER, I SUBMIT THAT THE LACK OF SAFETY CARRIES THE HIGHEST COST OF ALL--LOSS OF LIFE.

TRAVELLING WITH CHILDREN IS EXPENSIVE TO BEGIN WITH AND I WOULD NOT ADVOCATE INCREASING THAT BURDEN WITHOUT A VERY GOOD REASON. I BELIEVE THAT PROTECTING THEIR LIVES IS INDEED A GOOD REASON. IF INFANT SEATS ARE NOT REQUIRED, WE WILL CONTINUE TO TREAT OUR CHILDREN AS SECOND CLASS CITIZENS. HOW CAN WE DENY OUR CHILDREN THE SAME PROTECTION WE GIVE OURSELVES?

Mr. LAUGHLIN. At this time, we will continue with opening statements.

The gentleman from Iowa, Mr. Lightfoot?

Mr. LIGHTFOOT. Thank you, Mr. Chairman. I have a rather extensive statement. I would like to ask unanimous consent to be made part of the record.

Mr. LAUGHLIN. Without objection, so ordered.

Mr. LIGHTFOOT. In the interest of time, I will summarize and be, hopefully, considerably shorter.

You know, last year we had two aviation accidents: the crash of United Airlines flight 232 and Avianca Airlines Flight 52. Those two crashes brought the attention of the country to the inadequacy of the protection for youngsters and infants who are traveling by air. There were two toddlers that died in the United crash, at least one of whom might have been saved if he had been restrained. There were seven unrestrained children aged two and under who were injured in the Avianca crash, one of whom died. I am a commercial pilot, a flight instructor, and a volunteer FAA safety counselor who decided that the time had come that something should be done.

I think it has long recognized that adults should be restrained during turbulence, during take-offs, and during landings. Yet we allow children under the age of two to not be restrained. There is no excuse, in my opinion, for requiring coffee pots and corpses to be restrained and tied down, while leaving children under age two free to fly about the cabin. That is just sheer lunacy. This issue has been studied for years. It is time to quit studying. It is time to act. I don't think we can afford to wait any longer. It is time to get our heads out of the clouds.

Virtually all the experts agree that the small children should be better restrained during air travel as adults are. A report by Dr. Richard Snyder, who has done research on this subject for some 30 years and with the Civil Aeromedical Institute, stated, "Although parents on current airline flights are instructed to hold the infant under two years of age on their laps, from an occupant protection viewpoint, clasping in the mother's or father's arms offers virtually no protection at all when in the impact of the acceleration of a crash, or even in severe turbulence in flight."

The ridiculous part about this is that most parents are totally unaware of the risks that they are taking by holding their children in their laps. In fact, the National Safety Transportation Board issued a recommendation on May 22d of this year to the FAA that all infants and small children below the weight of 40 pounds and the height of 40 inches should be restrained in an approved child restraint device.

Since I took this issue on about a year ago, then was contacted by supporters of child restraint requirements from a broad spectrum of experts, even the NTSB and the Air Transport Association have added their voices to those calling for child restraints aboard aircraft. The only significant remaining opposition to this idea comes from, as the Chairman mentioned earlier, the FAA itself.

Unfortunately, the FAA's only objection, that I can determine, to the requirement appears to be one strictly of cost. FAA seems to be concerned that it will dissuade a great number of families from traveling by air. However, in viewing the public comments received by FAA on this proposed rule making on child restraints, my staff has discovered that there were 117 comments supporting a mandatory child restraint rule, and there were only 48 that opposed a mandatory rule. Of those comments indicating they were from parents, 21 favored a mandatory rule, while only 11 opposed it.

While we are on the subject of cost, I think it should be noted that any cost/benefit analysis of the costs of mandating restraints is purely speculative at its very best. Since we have absolutely no way of predicting how much, or even if, the airlines would charge for children under two, there is no way that we can come up with any kind of a legitimate figure.

As we are all aware, currently airlines allow children under two to fly free of charge. They are allowed to use vacant seats to install child restraint devices free of charge on flights where seats are open. Let's be direct. Cost is not the issue here. There is only one word, and that is safety. It is not cost. What is your child worth? Is it worth the price of an airline ticket? Anybody would tell me that it is.

I understand that FAA has prepared a cost/benefit report, which has not yet been made available to me. We did see a quick summary sheet on it. It apparently shows why FAA believes the increased cost to parents would cause more people to travel by auto, thus resulting in more deaths. First of all this is a little puzzling as to why FAA is more concerned about highway safety than it is about aviation safety.

Secondly, I'd like to take issue with the report's assumption. That is that I have been told that airlines would charge at least one-half the adult fare. That is purely an assumption. I'm sure that ATA would take issue with this assumption as well. I intend to ask that question when they testify later.

If you are going to base safety decisions strictly on cost, then why don't we require all passengers to bring their own oxygen on board? It's in the airplane. We pay for it in the ticket. How many of you in this room have ever had to use it? Why don't we require passengers to bring on their own seat belts? Why don't we have standing-room-only flights. How ridiculous do you want to get with this whole thing?

Last Fall, some 53 Members of the House joined me in sending a letter to the FAA requesting the implementation of child restraint requirements aboard aircraft. I'd hoped that this issue could be resolved administratively. I certainly wish that it would have been. Unfortunately, the need for legislation has now become obvious.

So therefore, on February 20th, I introduced H.R. 4025, which will require the FAA to implement child restraints requirements on aircraft. I think that it is important to point out that this bill has intentionally been worded in the least intrusive manner possible. The bill does not indicate what type of restraint must be used, merely that it must be FAA approved. We do not indicate in the bill who must provide that restraint. It also does not address the question of charges for the child under the age of two. We have left those issues to be determined by the FAA and the industry, working in cooperation with each other.

In particular, we recognize that currently approved auto restraint devices present problems, both in the level of protection they offer and just in the sheer bulk of the devices themselves. Unfortunately, auto restraints are currently the only devices that have been approved by the FAA for use during aircraft take-off, landing, and turbulence. It is the only game in town. We have to go with it.

What we are trying to do in our legislation is to give a framework in which FAA, NTSB, the airline industry can develop child restraints that are much easier to work with than child safety seats and possibly even be much more effective. That is why we have left the wording in this bill in such a manner that we leave the type of restraint required strictly up to the FAA with the hope of encouraging continued and stepped-up research into a more ideal restraint for aircraft use.

I think that should be one of the primary goals of our entire effort. However, I think it is clear to me also that protection provided to small children who fly is woefully inadequate. Therefore I intend to continue my effort towards the passage of H.R. 4025.

As we have mentioned earlier, Senator Bond has introduced a companion issue over on the Senate side. I want to thank Chairman Oberstar and Mr. Clinger for all their help in putting this hearing together today. I think we are going to hear some very good and very valuable testimony. I certainly appreciate the witnesses taking time to be with us. Mr. Chairman, thank you and I appreciate your co-sponsorship as well.

[Mr. Lightfoot's prepared statement follows:]

OPENING STATEMENT OF CONGRESSMAN JIM LIGHTFOOT
THE NEED FOR CHILD SAFETY RESTRAINTS ON AIRPLANES
HOUSE PUBLIC WORKS AND TRANSPORTATION
SUBCOMMITTEE ON AVIATION
THURSDAY, JULY 12, 1990

MR. CHAIRMAN, TWO AVIATION ACCIDENTS LAST YEAR, THE CRASH OF UNITED AIRLINES FLIGHT 232 AND AVIANCA AIRLINES FLIGHT 52, BROUGHT ATTENTION TO THE INADEQUACY OF PROTECTION FOR AIR TRAVELING INFANTS AND TODDLERS. TWO TODDLERS DIED IN THE UNITED CRASH - AT LEAST ONE OF WHOM MIGHT HAVE BEEN SAVED IF HE HAD BEEN RESTRAINED - AND SEVEN UNRESTRAINED CHILDREN AGE TWO AND UNDER WERE INJURED IN THE AVIANCA CRASH - ONE OF WHOM DIED. AS A PILOT, FLIGHT INSTRUCTOR, AND VOLUNTEER FAA SAFETY COUNSELOR, I DECIDED SOMETHING HAD TO BE DONE.

IT HAS LONG BEEN RECOGNIZED THAT ADULTS SHOULD BE RESTRAINED DURING TURBULENCE, LANDING AND TAKE-OFF. YET CHILDREN UNDER AGE TWO ARE NOT REQUIRED TO BE RESTRAINED. THERE IS NO EXCUSE FOR REQUIRING COFFEE POTS AND CORPSES TO BE RESTRAINED WHILE LEAVING CHILDREN UNDER AGE TWO TO FLY AROUND THE CABIN -- THAT'S SHEER LUNACY. THIS ISSUE HAS BEEN STUDIED FOR YEARS -- NOW IS THE TIME TO ACT. WE CAN'T AFFORD TO WAIT. IT'S TIME TO GET OUR HEADS OUT OF THE CLOUDS.

VIRTUALLY ALL EXPERTS AGREE THAT SMALL CHILDREN SHOULD BE BETTER RESTRAINED DURING AIR TRAVEL, JUST AS ADULTS ARE RESTRAINED. A REPORT BY DR. RICHARD SNYDER, WHO HAS DONE RESEARCH ON THIS SUBJECT FOR THE CIVIL AEROMEDICAL INSTITUTE (CAMI) IN OKLAHOMA CITY, STATED, "ALTHOUGH PARENTS ON CURRENT AIRLINE FLIGHTS ARE INSTRUCTED TO HOLD THE INFANT UNDER TWO YEARS OF AGE ON THEIR LAP, FROM AN OCCUPANT PROTECTION VIEWPOINT CLASPING THE CHILD IN THE MOTHER'S OR FATHER'S ARMS OFFERS VIRTUALLY NO PROTECTION AT ALL IN THE IMPACT DECELERATION OF A CRASH, OR EVEN IN SEVERE TURBULENCE IN-FLIGHT." THE RIDICULOUS PART OF THIS IS THAT MOST PARENTS ARE UNAWARE OF THE RISK THEY ARE TAKING WHEN HOLDING THEIR CHILDREN IN THEIR LAPS.

IN FACT, THE NATIONAL TRANSPORTATION SAFETY BOARD ISSUED A RECOMMENDATION ON MAY 22, 1990, TO THE FAA THAT ALL INFANTS AND SMALL CHILDREN BELOW THE WEIGHT OF 40 POUNDS AND HEIGHT OF 40 INCHES SHOULD BE RESTRAINED IN AN APPROVED CHILD RESTRAINT DEVICE.

AS EARLY AS 1978, A REPORT PREPARED BY RICHARD CHANDLER AND EDWIN TROUT OF CAMI STATED IN ITS INTRODUCTION, "THE NEED TO PROVIDE A SPECIAL MEANS OF PROTECTING INFANTS AND SMALL CHILDREN DURING A CRASH HAS BEEN RECOGNIZED FOR SEVERAL

YEARS, BUT THE FIRST FEDERAL REGULATORY SPECIFICATION FOR THESE DEVICES WAS NOT ADOPTED BY THE NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION UNTIL 1971." IT IS NOW 1990 - NEARLY 20 YEARS LATER - AND INFANTS AND TODDLERS STILL DO NOT HAVE ADEQUATE PROTECTION DURING AIR TRAVEL.

DR. RICHARD SNYDER, FORMERLY WITH CAMI AND NOW WITH BIODYNAMICS INTERNATIONAL, POINTED OUT THAT "THE FAA...REQUIREMENTS FOR CHILDREN'S RESTRAINT PROTECTION WERE NOT ISSUED UNTIL 1985. YET THE NEED IN AVIATION (FOR CHILD RESTRAINTS) HAD BEEN RECOGNIZED BY OTHER GROUPS OVER 25 YEARS EARLIER."

FOR EXAMPLE, AN APPEAL WAS MADE ON FEBRUARY 6, 1974, BY MR. STUART MILLER, IN THE FORM OF A PETITION TO FAA FILED TO REVISE PART 91, SUBPART A91.14, TO REQUIRE THAT CHILDREN UNDER AGE FOUR SHOULD BE RESTRAINED. MR. MILLER HAD DONE CONSIDERABLE WORK IN DESIGNING APPROPRIATE RESTRAINTS FOR CHILDREN. ON APRIL 2, 1976, IN RESPONSE TO HIS PETITION, THE FAA REQUESTED THAT MR. MILLER WITHDRAW HIS PETITION, "IN ORDER THAT THE AGENCY MAY AVOID DELAY ," IN VIEW OF THE CAMI TESTS THE "AGENCY IS FINALIZING DESIGN AND STRENGTH REQUIREMENTS FOR THESE DEVICES."

ON MAY 12, 1982, THE FAA ISSUED TECHNICAL STANDARD ORDER (TSO) C-100 PRESCRIBING MINIMUM PERFORMANCE STANDARDS THAT CHILD RESTRAINT SYSTEMS MUST MEET FOR USE IN AIRCRAFT, IN CONJUNCTION WITH FEDERAL MOTOR VEHICLE SAFETY STANDARD (FMVSS) 213 FOR AUTO RESTRAINTS WHICH BECAME EFFECTIVE ON JUNE 1, 1981. ON AUGUST 30, 1984, A FINAL RULE WAS PUBLISHED AMENDING FMVSS 213 TO CERTIFY CHILD RESTRAINTS AS SUITABLE FOR BOTH AUTO AND AIR TRAVEL USE. AT THAT POINT, TSO C-100 WAS REPLACED BY TSO C-100a.

UNFORTUNATELY, VIRTUALLY NO ACTION HAS TAKEN PLACE SINCE THAT TIME. ALTHOUGH WE HAVE DEVICES THAT HAVE BEEN CERTIFIED AS ACCEPTABLE FOR USE ON AIRCRAFT AND AUTOMOBILES, PARENTS ARE VIRTUALLY AS UNINFORMED, AND INFANTS AND TODDLERS ARE VIRTUALLY AS UNPROTECTED NOW AS THEY HAVE EVER BEEN. MANY PARENTS ARE UNAWARE OF THE DANGER TO WHICH THEIR SMALL CHILDREN ARE EXPOSED DURING AIR TRAVEL, AND AIRLINES CAN DENY PARENTS THE RIGHT TO USE A CHILD RESTRAINT. WHILE THE FAA HAS PUBLISHED IN THE FEDERAL REGISTER A PROPOSED REGULATION FOR VOLUNTARY CHILD RESTRAINT USE ABOARD AIRCRAFT, THIS PROPOSED REGULATION WOULD DO LITTLE TO INCREASE OVERALL SAFETY FOR AIR TRAVELING INFANTS AND TODDLERS. IT WOULD DIFFER LITTLE FROM PRESENT PRACTICE. I WAS PLEASED TO NOTE, HOWEVER, THE AIRLINE MEMBERS OF THE AIR TRANSPORT ASSOCIATION NOW HAVE A STATED POLICY OF ENCOURAGING THE USE OF CHILD RESTRAINTS.

SINCE I TOOK THIS ISSUE ON A YEAR AGO, I HAVE BEEN CONTACTED BY SUPPORTERS OF CHILD RESTRAINTS REQUIREMENTS FROM A BROAD SPECTRUM OF INTERESTS, INCLUDING FLIGHT

ATTENDANTS, PARENTS, AND SAFETY EXPERTS. EVEN THE NTSB AND THE AIR TRANSPORT ASSOCIATION HAVE ADDED THEIR VOICES TO THOSE CALLING FOR CHILD RESTRAINTS ABOARD AIRCRAFT. THE ONLY SIGNIFICANT REMAINING OPPOSITION TO THIS IDEA COMES FROM THE FAA ITSELF. AND UNFORTUNATELY, THE FAA'S ONLY OBJECTION TO THIS REQUIREMENT APPEARS TO BE ONE OF COST. THE FAA SEEMS TO BE CONCERNED IT WILL DISSUADE A GREAT MANY FAMILIES FROM TRAVELING BY AIR. HOWEVER, IN REVIEWING THE PUBLIC COMMENTS RECEIVED BY FAA ON ITS PROPOSED RULEMAKING ON CHILD RESTRAINTS, MY STAFF FOUND 117 COMMENTS SUPPORTING A MANDATORY CHILD RESTRAINT RULE, AND ONLY 48 OPPOSING A MANDATORY RULE. OF THOSE COMMENTS INDICATING THEY WERE FROM PARENTS, 21 FAVORED A MANDATORY RULE WHILE ONLY 11 OPPOSED A MANDATORY RULE.

WHILE ON THE SUBJECT OF COST, IT SHOULD BE POINTED OUT THAT ANY COST-BENEFIT ANALYSIS ON THE COST OF MANDATING CHILD RESTRAINT USE ON AIRLINES IS SPECULATIVE, SINCE WE HAVE NO WAY TO PREDICT HOW MUCH, OR EVEN IF, AIRLINES WOULD CHARGE FOR CHILDREN UNDER AGE TWO. AS WE KNOW, U.S. AIRLINES CURRENTLY PERMIT CHILDREN UNDER AGE TWO TO FLY FREE OF CHARGE AND TO USE VACANT SEATS FOR INSTALLING CHILD RESTRAINT DEVICES FREE OF CHARGE. HOWEVER, LET ME BE DIRECT -- COST IS NOT THE ISSUE HERE; SAFETY IS -- SAFETY.

I UNDERSTAND THE FAA HAS PREPARED A COST-BENEFIT REPORT - WHICH HAS NOT YET BEEN MADE AVAILABLE TO ME - SHOWING WHY FAA BELIEVES THE INCREASED COST TO PARENTS WOULD CAUSE MORE PEOPLE TO TRAVEL BY AUTO, THUS RESULTING IN MORE DEATHS. FIRST OF ALL, I AM A LITTLE PUZZLED AS TO WHY FAA SEEMS MORE CONCERNED ABOUT HIGHWAY SAFETY THAN AIRCRAFT SAFETY. SECONDLY, I WOULD LIKE TO TAKE ISSUE WITH THE REPORT'S ASSUMPTION, AS I'VE BEEN TOLD, THAT THE AIRLINES WOULD CHARGE AT LEAST ONE-HALF THE ADULT FARE - AND I'M SURE THE ATA WOULD TAKE ISSUE WITH THIS ASSUMPTION AS WELL. IF YOU'RE GOING TO BASE SAFETY DECISIONS STRICTLY ON COST, WHY NOT REQUIRE ALL PASSENGERS TO BRING ABOARD THEIR OWN OXYGEN? THAT HA A COST AS WELL, YET LOOK HOW SELDOM OXYGEN IS NEEDED ABOARD AIRPLANES. WHY NOT SELL STANDING-ROOM-ONLY TICKETS, OR ALLOW CHILDREN UP TO AGE THREE OR AGE FIVE TO FLY FREE IF RIDING IN THEIR PARENTS' LAPS? THESE OPTIONS MAKE JUST ABOUT AS MUCH SENSE.

LAST FALL, 53 MEMBERS OF THE HOUSE OF REPRESENTATIVES JOINED ME IN SENDING A LETTER TO THE FAA REQUESTING THE IMPLEMENTATION OF A CHILD RESTRAINT REQUIREMENT ABOARD AIRCRAFT. I HAD HOPED THIS ISSUE COULD BE RESOLVED ADMINISTRATIVELY. UNFORTUNATELY, THE NEED FOR LEGISLATION HAS BECOME OBVIOUS. THEREFORE, ON FEBRUARY 20, I INTRODUCED H.R. 4025 TO REQUIRE THE FAA TO IMPLEMENT CHILD RESTRAINT REQUIREMENTS ON AIRCRAFT. TO DATE, 46 MEMBERS OF THE HOUSE HAVE COSPONSORED THIS LEGISLATION.

IT IS IMPORTANT TO POINT OUT THAT THIS BILL HAS

INTENTIONALLY BEEN WORDED IN THE LEAST INTRUSIVE MANNER POSSIBLE FOR A MANDATORY RULE. THE LEGISLATION DOES NOT INDICATE WHAT TYPE OF RESTRAINT MUST BE USED, MERELY THAT IT MUST BE FAA-APPROVED, OR WHO MUST PROVIDE THE RESTRAINT. IT ALSO DOES NOT ADDRESS THE QUESTION OF CHARGES FOR THE CHILD UNDER AGE TWO. WE HAVE LEFT THESE ISSUES TO BE RESOLVED BY THE INDUSTRY AND THE FAA. IN PARTICULAR, WE RECOGNIZE CURRENTLY APPROVED AUTO RESTRAINT DEVICES PRESENT PROBLEMS BOTH IN THE LEVEL OF PROTECTION THEY PROVIDE AND THE SHEER BULK OF THE RESTRAINT ITSELF. UNFORTUNATELY, AUTO RESTRAINTS ARE CURRENTLY THE ONLY DEVICES WHICH HAVE BEEN APPROVED BY FAA FOR USE ON AIRCRAFT. FOR THIS REASON, H.R. 4025 LEAVES THE TYPE OF RESTRAINT TO BE REQUIRED UP TO THE FAA, WITH THE HOPE OF ENCOURAGING CONTINUED AND STEPPED-UP RESEARCH ON AND APPROVAL OF A MORE IDEAL RESTRAINT FOR AIRCRAFT USE. THAT SHOULD BE ONE OF OUR PRIMARY GOALS IN THIS WHOLE EFFORT.

SENATOR CHRISTOPHER BOND, WHO HAS BEEN INVITED TO TESTIFY BEFORE THE SUBCOMMITTEE TODAY, HAS INTRODUCED IDENTICAL LEGISLATION IN THE SENATE. ON APRIL 4, SENATOR BOND AND I ALSO JOINTLY SUBMITTED A LETTER OF COMMENT ON THE FAA'S PROPOSED RULEMAKING ON CHILD RESTRAINTS.

I MUST THANK YOU, MR. CHAIRMAN, AND MY RANKING MEMBER, MR. CLINGER, FOR CALLING THIS HEARING. I WELCOME THE TESTIMONY OF THOSE APPEARING BEFORE THE PANEL TODAY, AND I LOOK FORWARD TO THE OPPORTUNITY TO QUESTION THEM. THANK YOU.

Mr. LAUGHLIN. Thank you, Mr. Lightfoot, and I appreciate your leadership in bringing this very important bill for child restraints on aircraft to us. I am very pleased to join you in co-sponsoring this bill.

As I listen to the injury reports for infants on aircraft, I am reminded of a law suit I participated in when I practiced law in Houston. There was a car wreck. All of the adults in the two cars were wearing seat belts and none of them were injured. Yet, an infant was impaled upon the floor shift of an automobile and was the only injury and the only death out of that automobile collision in which none of the adults went to the hospital. So it always has been a memory to me that we adults have no higher responsibility on this good earth above taking care of those infants who do not have the ability, the physical capability, of offering themselves even the minimum protection in an injury or accident situation.

I commend the airlines for their humanitarian approach to mothers, fathers and grandparents for having the policy of permitting children and infants, of two years of age or younger, to fly free in the laps of their mothers, fathers, or grandparents. I think you should be encouraged to continue that policy because many flights are not filled to 100 percent capacity. It would be a good gesture to the traveling public and certainly a goodwill gesture for which you should get adequate advertising benefits. At the same time, on those peak flights when mothers or fathers who identify themselves as having an infant two years of age or younger, offer them the off-peak flights with the availability of flying free with that child in some type of restraint.

I am reminded of just a few weeks ago of the only time, Mr. Lightfoot, I have seen this happen. It is not an advertisement for Southwest Airlines, because they do not fly non-stop from Washington to Houston. I was on a flight from Houston to Dallas recently, and a young mother got on board with what I recognized to be a car seat for her several month old infant, the kind of car seat Ginger and I used when our children were infants. The flight attendant assisted the mother in showing her how to position that car seat in the airplane seat and how to use the straps, same as Ginger and I used on the car seat in our automobile, to secure and protect that infant from any disruption during the flight. That infant did not have the ability to put on a seat belt and did not have the ability to get the oxygen mask or any other item of safety. I commend that young flight attendant and Southwest Airlines for having the policy, at least in that instant, whether it is a company policy or just a young lady helping a young mother. That is the sort of thing that I think our American carriers can do to assist our traveling parents and help the family continue their travels, such as the ranking Republican and the Chairman of this Committee, to visit other family members.

Mr. LIGHTFOOT. Would the gentleman yield on that point?

Mr. LAUGHLIN. Yes.

Mr. LIGHTFOOT. Doesn't it seem rather ironic that unless you walk or ride a horse to the airport and are going to leave the airport either on horseback or on foot, that the child has to be restrained in the safety seat. It is state law virtually across the

Nation at this point in time. But the time that that child is in the air they can just be free to fly it wherever it would want to go.

Mr. LAUGHLIN. It is ironic and it is sad at the same time. I would point out to the gentleman that recently I was reading a newspaper as I stepped into a car and forgot to put my seat belt on. An aide was driving and we had not gone two blocks when he got stopped, not for speeding or running a red light, but because I did not have my seat belt on. He was not traveling at any high speed. We could have had, literally, a head-on collision and I do not think either one of us would have been injured. It is a sad commentary on our concern, or lack of concern, for the safety of infants that we do not have the FAA with a policy to protect our infants, and now there is a necessary situation that we go forward with the bill. Those are my observations.

At this time, I would recognize the gentleman from New York, Mr. Boehlert.

Mr. BOEHLERT. Thank you, Mr. Chairman? I, too, have co-sponsored Mr. Lightfoot's bill. I recognize the concern that young parents with children have relative to costs, and hopefully this hearing will help us to work out that dilemma.

Thank you.

Mr. LIGHTFOOT. Mr. Chairman, I ask unanimous consent that the opening statement of Congressman McEwen from Ohio also be entered in the record.

Mr. LAUGHLIN. Without objection it is so ordered.

[Mr. McEwen's prepared statement follows:]

STATEMENT
OF
THE HONORABLE BOB MCEWEN
BEFORE THE SUBCOMMITTEE ON AVIATION
HEARING ON
PROPOSED CHILD SAFETY RESTRAINT SYSTEMS

JULY 12, 1990

10:00 A.M. 2167 RHOB

MR. CHAIRMAN I OPPOSE LEGISLATION WHICH WOULD MANDATE THE USE OF CHILD RESTRAINTS ON AIRCRAFT. I AM CONCERNED THAT THIS TYPE OF LEGISLATION WILL ONLY INCREASE THE COST OF AIR TRAVEL FOR FAMILIES WITH SMALL CHILDREN, WITHOUT MEASURABLY IMPROVING AIR SAFETY.

THIS LEGISLATION WOULD BE CONTENT TO HAND THE AIRLINES 10,000 MORE PAYING PASSENGERS EACH DAY. THIS IN TURN WOULD GIVE THE AIRLINES AN ADDITIONAL 119 MILLION DOLLARS OF REVENUE IN THE FIRST YEAR AFTER IT WOULD BECOME LAW -- MONEY WHICH WILL COME STRAIGHT OUT OF THE CONSUMERS' POCKET WITH NO GUARANTEE OF SAFER TRAVEL.

THE TRAGIC MEMORIES FROM UNITED FLIGHT 232 AND AVIANCA FLIGHT 52 ARE STILL VERY REAL AND DISTRESSING. THREE CHILDREN WERE AMONG THE 185 FATALITIES IN THESE TWO TRAGIC ACCIDENTS, BUT NO ONE KNOWS IF CHILD RESTRAINTS WOULD HAVE SAVED THOSE CHILDREN, AND MANY CHILDREN SURVIVED THOSE FLIGHTS WHO WERE NOT BUCKLED INTO THEIR OWN SEATS.NED.

DURING THE LAST 15 YEARS THE FAA HAS BEEN ABLE TO IDENTIFY ONLY EIGHT IN-FLIGHT INFANT DEATHS OR SERIOUS INJURIES. IN ADDITION, A 1982 HARVARD STUDY PREDICTED THAT CHILD RESTRAINTS MIGHT SAVE THREE LIVES IN FIVE YEARS. THE NUMBER OF CHILDREN THIS MANDATE WILL SAVE IS PURELY SPECULATION, AND SWEEPING GOVERNMENT LEGISLATION SHOULD NOT BE BASED ON SPECULATION.

THE EMOTIONAL ARGUMENT OF THOSE WHO SAY, ANYTHING WHICH WILL SAVE THE LIFE OF A CHILD IS WORTH IT, ARE BOTH UNDERSTANDABLE AND ADMIRABLE. THE LIFE OF A CHILD IS A TREASURE BEYOND MEASURE AND THE PROTECTION OF CHILDREN IS A GOAL SHARED BY EVERYONE. BUT THERE IS DISTURBINGLY LITTLE EVIDENCE TO BACK UP THEIR CLAIMS THAT INFANT RESTRAINTS ARE WORTH IT.

NO ONE KNOWS HOW MANY CHILDREN THIS MIGHT HELP.

NO ONE KNOWS HOW MANY INFANTS HAVE SURVIVED AIR CRASHES WITHOUT CHILD RESTRAINTS.

NO ONE KNOWS WHETHER A PARENT WOULD BE CONTENT TO KEEP A CHILD IN A SEPARATE SEAT DURING THE FLIGHT, MUCH LESS DURING AN ACCIDENT.

AND NO ONE KNOWS HOW DIFFICULT IT MIGHT BE TO DISENGAGE A CHILD FROM A SAFETY RESTRAINT IN THE CHAOS WHICH FOLLOWS A CRASH.

I DO KNOW ONE THING, MANY PARENTS WOULD HAVE TO TRAVEL BY CAR AS A RESULT OF THE INCREASED COSTR OF AIR TRAVEL. AND WE KNOW FOR SURE THAT CARS ARE THE NUMBER ONE CAUSE OF CHILDHOOD DEATH BY INJURY, WHILE DEATHS AS A RESULT OF AVIATION ACCIDENTS RANKS 22ND.

THE FAA HAS PROPOSED A REASONABLE COMPROMISE. AIRLINES SHOULD BE REQUIRED TO LET PARENTS DECIDE IF THEY WANT SAFETY SEATS FOR THEIR CHILDREN. PARENTS SHOULD HAVE THE CHOICE, BUT TO IMPOSE ADDITIONAL EXPENSES ON PARENTS TO PROTECT CHILDREN FROM SUCH A SMALL RISK IS WRONG.

IT MIGHT MAKE A FEW GOVERNMENT OFFICIALS FEEL BETTER. IT MIGHT MAKE MONEY FOR SOME AIRLINES. BUT IT WILL MAKE IT TOO EXPENSIVE FOR SOME FAMILIES TO FLY. EVEN WORSE IT COULD FORCE FAMILIES TO TAKE THE TRIP BY CAR, AND THAT WOULD BE MORE DANGEROUS.

I WANT TO EXPRESS MY APPRECIATION TO YOU, MR. CHAIRMAN, AND TO THE RANKING MEMBER, MR. CLINGER FOR THIS HEARING ON THIS ISSUE. I WANT TO JOIN YOU IN WELCOMING THE WITNESSES HERE TODAY.

Mr. LIGHTFOOT. I also would like to place in the record statements from the Honorable John Paul Hammerschmidt and the Honorable Ron Packard.

Mr. LAUGHLIN. Without objection, so ordered.

[The statements of Mr. Hammerschmidt and Mr. Packard follow:]

STATEMENT OF
THE HONORABLE JOHN PAUL HAMMERSCHMIDT
BEFORE THE SUBCOMMITTEE ON AVIATION
HEARING ON CHILD SAFETY SEATS

JULY 12, 1990 1:00 P.M.

2167 RAYBURN HOB

MR. CHAIRMAN:

AS YOU SAID, THIS HEARING WILL CONSIDER THE ISSUES INVOLVED IN REQUIRING CHILD SAFETY SEATS ON BOARD COMMERCIAL AIRCRAFT.

THESE ISSUES WERE BROUGHT TO THE FOREFRONT BY TWO RECENT AIRLINE ACCIDENTS -- THE UNITED AIRLINES CRASH LAST YEAR IN IOWA AND THE AVIANCA CRASH LAST JANUARY ON LONG ISLAND. IN BOTH CASES, SEVERAL INFANTS WHO WERE NOT IN SAFETY SEATS WERE EITHER INJURED OR KILLED.

WE ALL KNOW THAT INFANT SAFETY SEATS ARE REQUIRED FOR AUTO TRAVEL, BUT THE ISSUE IS MORE COMPLEX IN THE CASE OF AIR TRAVEL. IN THAT CASE, PARENTS WHO WANT TO PLACE THEIR CHILD IN A SAFETY SEAT MAY HAVE TO PAY TO RESERVE SPACE ON THE FLIGHT. GIVEN THE INCREASING COST OF AIRLINE TRAVEL, THE COST OF THIS COULD BE QUITE HIGH FOR MANY FAMILIES.

NOW, IT GOES WITHOUT SAYING THAT A CHILD IS PRECIOUS AND NO COST SHOULD BE TOO HIGH TO MAKE THAT CHILD SAFE. HOWEVER, A CONCERN IS THAT SOME MIGHT DECIDE TO FOREGO FLYING ALTOGETHER OR TAKE THE TRIP BY CAR INSTEAD, IF A SAFETY SEAT REQUIREMENT WERE IMPOSED BY THE FEDERAL GOVERNMENT.

THERE ARE MANY MORE ACCIDENTS, INJURIES AND DEATHS INVOLVING AUTO TRAVEL THAN THERE ARE INVOLVING AIR TRAVEL. WE CERTAINLY WOULDN'T WANT MORE CHILDREN TO DIE ON THE HIGHWAYS SIMPLY BECAUSE THEY COULDN'T AFFORD TO FLY. BUT THIS IS PRECISELY THE POSSIBILITY THAT WAS RAISED BY A RECENT STUDY OF CHILD SAFETY SEATS.

THERE MAY BE WAYS TO RESOLVE THIS DILEMMA. FOR EXAMPLE, SPACE COULD BE OFFERED TO INFANTS ON PLANES AT A SUBSTANTIAL DISCOUNT. THAT IS THE SORT OF APPROACH THAT SHOULD BE ADDRESSED IN THIS HEARING. AS ALWAYS, OUR NUMBER ONE PRIORITY SHOULD BE THE SAFETY OF OUR NATION'S CHILDREN.

THEREFORE, MR. CHAIRMAN, I WOULD LIKE TO THANK YOU FOR CALLING THIS HEARING. I WOULD ALSO LIKE TO ESPECIALLY RECOGNIZE THE CONTRIBUTION OF OUR COLLEAGUE FROM IOWA, JIM LIGHTFOOT, WHO HAS TAKEN THE LEAD ON THIS ISSUE. HIS BILL IS THE MAIN FOCUS OF THIS HEARING.

THANK YOU.

STATEMENT OF
THE HONORABLE RONALD C. PACKARD
REPRESENTING THE
43RD DISTRICTOF CALIFORNIA
BEFORE THE
SUBCOMMITTEE ON AVIATION
JULY 12, 1990

MR. CHAIRMAN. THANK YOU FOR CALLING THIS HEARING. THE PROTECTION OF OUR CHILDREN FROM INJURY WHILE ABOARD AIRPLANES DESERVES THIS COMMITTEE'S ATTENTION. I WOULD ALSO LIKE TO THANK OUR COLLEAGUE, CONGRESSMAN LIGHTFOOT FOR CRAFTING LEGISLATION THAT WOULD PROTECT OUR CHILDREN. I AM A PROUD COSPONSOR OF HIS BILL.

I LOOK FORWARD TO HEARING THE TESTIMONY OF TODAY'S WITNESSES. BOTH SIDES OF THIS ISSUE WILL BE EXPLORED. SEVERAL SAFETY ADVOCACY GROUPS HAVE LENT THEIR SUPPORT TO THE LIGHTFOOT BILL. THE NATIONAL TRANSPORTATION SAFETY BOARD VOTED UNANIMOUSLY TO SUPPORT USE OF CHILD RESTRAINT ON COMMERCIAL AIRCRAFT. IT IS THE INTENTION OF THE

LEGISLATION TO PROTECT THE LIVES OF CHILDREN. STUDY AFTER STUDY HAS CONCLUDED THAT CHILDREN SEATED IN THE LAP OF A PARENT ARE AT SEVERE RISK IN THE EVENT OF AN ACCIDENT.

NO SUPPORTER OF THIS LEGISLATION WISHES TO PLACE A LARGE FINANCIAL BURDEN UPON PARENTS WITH SMALL CHILDREN. I HOPE THAT THIS HEARING WILL POINT THAT SAFETY IS THE REAL ISSUE AT STAKE HERE TODAY. THE FINANCIAL ASPECT OF THIS BILL SHOULD BE EXAMINED AND DISCUSSED. WE CERTAINLY DO NOT INTEND TO PRICE YOUNG PARENTS OUT OF THE MARKET. I HOPE THAT THIS HEARING CAN HELP RESOLVE THIS ISSUE SO THAT WE CAN MOVE THE LIGHTFOOT BILL AND PROTECT OUR CHILDREN THAT FLY OUR AIRWAYS AS A MEANS OF TRAVEL.

I WOULD LIKE TO WELCOME SENATOR CHRISTOPHER BOND AND ALL OTHER WITNESSES SCHEDULED TO APPEAR HERE TODAY TO DISCUSS THIS IMPORTANT MATTER. THANK YOU MR. CHAIRMAN.

Mr. LAUGHLIN. At this time, we will call the Honorable Susan Coughlin, Vice Chairman, National Transportation Safety Board, to the witness table.

TESTIMONY OF HON. SUSAN M. COUGHLIN, VICE CHAIRMAN, NATIONAL TRANSPORTATION SAFETY BOARD, ACCOMPANIED BY NORA MARSHALL, SENIOR ACCIDENT INVESTIGATOR, SURVIVAL FACTORS DIVISION

Ms. COUGHLIN. Thank you, Mr. Chairman and Members of the Committee. I want to thank the whole committee for the opportunity to present the views of the National Transportation Safety Board concerning child restraints on aircraft.

Before I begin, I would like to introduce Nora Marshall, who is with me today, a senior accident investigator in the Board's Survival Factors Division.

Mr. Chairman, the Safety Board shares your concern about protecting infants and small children aboard aircraft. We look forward to early implementation of regulations that will require children to occupy approved restraint devices.

In general, the probability of survival following an air crash has improved in recent years. Yet improvements in survivability for infants has not kept pace with those for other passengers. For example, while the FAA has required improvements in seat strength for belted occupants, infants continue to be restrained in the same way that they were fifty years ago, in the arms of an adult. And as this Committee knows, the FAA currently requires that all occupants be restrained for take-off, landing and turbulent conditions, except those occupants who have not yet reached their second birthday. Those occupants are permitted to be held in the arms of an adult. The Safety Board believes that the FAA's decision to allow this is a contradiction of basic safety practices and represents an inconsistency that must be corrected.

The plain fact is that children held in the laps of adults are not being afforded the same level of protection from injury as restrained occupants. The tremendous forces at impact are simply too great for children to be secured in the arms of their parents. They can and probably will be injured as they are tossed about the cabin and their parents may not be able to find them quickly and evacuate them safely.

Contrast, if you will, that passengers are not allowed to hold other objects, even ones weighing much less than an infant, on their laps during take-off and landing. Why a child?

In July, 1989, as all of you are aware, a DC–10 aircraft crashed during an attempted emergency landing in Sioux City, Iowa. We all know the details of that tragic accident. Testimony received from survivors following the accident underscored problems that affected the survivability and safety of unrestrained children during that crash. FAA researchers themselves have vividly demonstrated with dummies of varying weights that holding on to an infant is difficult, even in aviation crashes and accidents involving minor inertial loads. The Safety Board can cite numerous examples of similar situations going back to as far as 1978, which demonstrate the need for greater protection for small children.

In 1978, an air accident in Portland, Oregon, prompted the Safety Board to issue its first recommendation to the FAA regarding infant restraint. In response, the FAA first allowed the use of some automobile restraint devices in 1982, but stopped short and did not require them.

The Board is disappointed that the FAA action has not resulted in the wide-spread use of child restraints on aircraft. In fact, surprisingly enough, the Safety Board knows of no fatal air carrier accident in which any child was using an FAA approved child restraint device. The use of child restraints is not common among children of any age regardless of whether they had to purchase a ticket for their flight.

In 1985, the FAA issued a new order that broadened the number and type of child restraint devices that could be used on board aircraft, but again it did not require their use.

Another problem for unrestrained occupants are turbulence encounters. Although turbulent situations are much less severe than crash impacts, they nevertheless put unrestrained children at risk. These unrestrained infants and children then become risks to other passengers. Safety Board investigations have revealed infants who were injured during turbulence. For example, on January 20, 1990, a seven-week old infant sustained a serious head injury when a DC-10 encountered turbulence near San Juan, Puerto Rico. The child was the only occupant to receive serious injuries. The only method available to that child to protect him was his mother's grasp, and it was not adequate.

In testimony at the Safety Board's accident investigation hearing last October in Sioux City, an FAA witness stated that infants are best protected in an FAA approved infant-child restraint system that was properly installed in a seat. The Safety Board completely agrees with this statement.

On May 30, 1990, the Board recommended that the FAA require that infants and small children under the weight of 40 pounds and less than 40 inches high be restrained in an approved child restraint system appropriate to their size. This recommendation will protect children under the age of two who are presently covered by no regulations as well as children over the age of two who are less than 40 pounds and 40 inches tall.

In conclusion, Mr. Chairman, the Safety Board believes that unrestrained infants and small children are not being offered the same level of protection as other occupants, and objects, I might add, on an airplane, and that these unrestrained children and infants expose other occupants in the cabin to increased risk of injury. The Safety Board believes that the FAA's policy of voluntary use of child restraints has been ineffective and that the time has come to ensure that all occupants are afforded an equal level of safety.

Mr. Chairman, that concludes my formal statement. I will certainly be pleased to respond to any questions that the Committee may have.

Mr. OBERSTAR [resuming chair]. Thank you, very much, Madam Chairman. I appreciate your testimony today.

I want to compliment the NTSB on its vigilance in this and so many other areas of safety. You are strong and credible and a consistently effective voice for safety, whether it is highway safety, or rail safety, or pipeline safety or aviation. As Chair over the past four years of the Investigations and Oversights Subcommittee, I think that you, your predecessors, and certainly your permanent staff, certainly know the great reliance that the Subcommittee has had on the splendid work of the NTSB. We feel that you are underfunded, understaffed, and that you ought to be at a level, certainly above that which prevailed in 1980, that in staffing the agency is a decade behind and the subcommittee is attempting to rectify that shortcoming in the reauthorization bill that we have reported and hope soon to bring to the House floor.

Ms. COUGHLIN. We appreciate that support, Mr. Chairman.

Mr. OBERSTAR. Some years ago, there was a comparative analysis that I did on the cost of safety. We are always making those judgments. What does safety cost? We are trying to balance costs against benefits, but in this case, in one thing to balance costs/benefit of an FDA regulation, or a USDA regulation, or a 404 permit, or a discharge permit under EPA, but in this area we are talking about a commodity that shouldn't even bear that term, it is human life. What price tag do we put on human life?

We have taken a number of actions with respect to highway safety, such as removing fixed obstacles that are death traps on the highways, in the gore areas, the v-shaped areas at exits, where people are at an indecision point and come to a stop on a high-speed highway. Some road-side obstacles have been removed, others have been redesigned to break away if hit, rather than killing car occupants. For a cost of about $785,000 per mile, we can make highways safer or accidents less dangerous. For $15, as little as a few years ago, with a seat belt, we can save more lives for far less cost.

Here we are arguing in this matter on board aircraft, trying to balance human life, injury to human beings, against costs. You have given very, very humane and thoughtful testimony and it is very much appreciated. I would like to know what is your response to predictions that lives will be lost because parents may choose to drive instead of to fly?

Ms. COUGHLIN. Mr. Chairman, we've certainly heard those arguments. I must tell you I have difficulty accepting those arguments. I believe, though I am not discounting the seriousness of highway safety, and I believe that the NHTSA and the FHWA are making an attempt to improve highway safety, but I think we are confusing the issues when we start comparing aviation safety to highway safety. The FAA, the ones to whom we addressed this recommendation, are responsible for aviation safety. There is no one who is making the argument that we are not safer buckled in and restrained in those seats during the critical phases of flight. So I have a hard time accepting the intertwining of those issues.

I also think that as I was listening to the various arguments, that there is not only a financial investment involved here, but there is a time investment involved here. I have a hard time accepting the argument that because of an extra cost people will automatically make the decision to drive rather than to fly. I think there is more than just an economic cost involved here aside from the safety issue, that there are other considerations as well. I have a hard time accepting the argument.

Even if it were to drive more people to the highway, what we are dealing with here today is aviation safety and the right thing to do is to require all occupants to be restrained.

Mr. OBERSTAR. Have you done, or do you have access to critique of the cost analysis that FAA has completed?

Ms. COUGHLIN. No, sir, I don't. I am not aware that anyone on the Board does have it. I would also not be telling you anything that would be a surprise, but the Board is not, by mandate, required to be concerned with cost/benefit. It is also my belief that most parents would view the investment in an airline ticket a good investment if they perceived that there was any possibility that it would enhance their family's safety.

Mr. OBERSTAR. Do you think it might be a good idea if the FAA had the same mandate not to be concerned with the cost implications of safety and leave that up to the Department?

Ms. COUGHLIN. I don't know that I would make that statement. I think they have to be concerned, as they traditionally have, with cost/benefit. I think that is appropriate, yes, sir. But I think that NTSB is in an enviable position as a watchdog over safety of not having that mandate.

Mr. OBERSTAR. I think it is absolutely appropriate, vitally important, for NTSB's role. It just might be a good idea that FAA have the same freedom when it comes to safety. Let another entity make those cost/benefit analyses. That's an obiter dictum to the point of this hearing, nevertheless one that we ought to think about.

You suggest that child restraint usage has not increased since 1985. Do you have any thoughts about why that may be?

Ms. COUGHLIN. It is puzzling. We have not seen, as I mentioned, any fatal air crash in which we have identified an FAA approved child restraint on board. I think that probably there are several reasons that one might point to, but I have no body of firm, scientific information to back this up. I don't think that parents totally understand the G-forces involved in an air crash. I believe that most parents firmly believe that they can hold on to that child. I think that is one of the factors.

I think another factor is that we probably haven't done a very good education job in letting them know the safety benefits of using those seats. But I think probably the biggest reason is confusion. People have talked about that confusion prior to my testimony. There is a lot of uncertainty on the part of the parent, on the part of the airline, on the part of the gate agent, on the part of the flight attendant. Parents probably have arrived at the gate and been turned away or been forced to check their infant seat. But there are a lot of reasons, education is probably one of them. We need to do a good job on that. We need to do a much better job, particularly since today we are faced with a voluntary situation which we believe is ineffective.

Mr. OBERSTAR. I think you're point is right on target. I will yield to other members now, but not without an observation. That is we Americans respect life. We treasure life. Yet, we resist bitterly being told to protect our own lives. Witness the uproar over the safety belt lock device that made it so that you couldn't start your car unless the safety belt was in place. Quite some years ago, a motorcycle safety helmet law was passed in the State of Wisconsin requiring motorcyclists to wear a helmet. Great outcry arose among cyclists. A petition drive was initiated to the Wisconsin State Legislature to repeal the law. "Let us make our own decisions about safety on motorcycles," petitioners asked. The Wisconsin Legislature, which is my next-door State, responded and repealed that law. Within a week after repeal, a motorcyclist was killed in a head-on crash, not wearing a helmet. It turns out he was the first person to sign that petition.

It would be a terrible tragedy should we leave this stone unturned.

Ms. **COUGHLIN**. And unfortunately, those young occupants don't have a choice. They don't have the ability to make that choice. Somebody has to make it for them.

Mr. **OBERSTAR**. That's the exclamation point. Thank you.

Ms. **COUGHLIN**. Thank you.

Mr. **OBERSTAR**. Mr. Clinger.

Mr. **CLINGER**. Thank you very much. I would just like to join in welcoming Ms. Coughlin to the hearing. I think we have a sort of historical moment, because as you were testifying here I was just in the Cloak room and Congressman Coughlin is just speaking on the floor of the House.

Ms. **COUGHLIN**. The dog's there.

Mr. **CLINGER**. But we are delighted to have you here and to have your testimony.

One question that occurs is, if it could be conclusively established—I am not sure that it could be, or certainly has not been to my satisfaction—that in fact more children would die as a result of requiring the restraint in airplanes because there would be more people traveling in cars and so forth, would your recommendation be the same?

Ms. **COUGHLIN**. In the absence of that conclusive proof, my sense would be yes. We are dealing with aviation safety. We think that there is a gap in the protection that is being offered out there. One would hope that if we saw a dramatic upswing in the deaths on the highway that we would address ourselves doubly to that issue. I think the Board and the DOT have been tremendously responsible in trying to face issues where we see upswings in numbers. But I have to tell you, Congressman, I am skeptical of that thought. I think that as creative and competitive as airlines today are, that a way will be developed to help parents deal with the costs. I find it hard to believe otherwise.

As I said earlier, I think there is something other than the economic investment. There is an investment of time. I don't know how many families of four would start off from Washington, DC, to go to Disneyland by car because they had to pay an extra $200 for a ticket, or $300, or $50. I am just not sure it's a valid argument. In the absence of empirical data, that is my reaction. We would make this same recommendation in the interest of safety for those children.

Mr. **CLINGER**. We have had a certain study presented to us by the FAA. It would be interesting to have the Board's comments or analysis of those studies, if you could provide them for us.

Ms. COUGHLIN. Yes, sir. Once we have had a chance to see it and analyze it, we certainly will.

Mr. CLINGER. As I know you know, oftentimes passengers will survive the crash, but then die as a result of being unable to evacuate quickly enough because of fire or smoke or whatever. Would it make it more difficult to evacuate small children if they are strapped into a safety seat? Would that slow down the evacuation process? Is that a concern?

Ms. COUGHLIN. There is no question that any time you have a new regulatory environment that there will be issues and areas in that regulation that require some very careful thinking through and some very careful education on the part of flight attendants, on how you brief parents in the event of an emergency. And yes, I think we need to very carefully look at issues of evacuation, which is one of the reasons we might, as we move down the way with this eventual legislation or regulation, want to give some careful consideration to allowing parents to bring their own safety seats. Parents are more familiar with the operation of that seat. In an emergency the likelihood of a flight attendant being available to help a parent get the child out of the seat that the airline has provided is probably fairly slim. They are off doing other emergency type efforts in that kind of an emergency. I think also the location of infant seats is of concern. We obviously don't want them seated at exits. We have to plan very carefully, and educate very carefully on proper procedures once these seats are required, which I very much hope they will be.

Mr. CLINGER. I had an opportunity to go down and go through Delta Airlines' operation to see how easy it was to evacuate. One of the concerns I would have is that once you take the window out for example, it is a pretty bulky item. When you remove that window and put it in the seat, then you still have a pretty bulky seat there that might be difficult to get out.

Ms. COUGHLIN. As I am sure you are aware, Congressman, one of the efforts underway to study this issue is through the Air Transport Association. It has done a fair amount on that, and they will undoubtedly speak to that today. They are attempting to develop what might be a more acceptable, a smaller, more compact seat. They will look at the engineering aspects of those seats to see if there is a way that we can minimize what might add a safety hazard, if you will. At this point I would not say that that would stand in the way of our saying that we still believe the seats are a very good idea.

Mr. CLINGER. Then you would agree that it might require perhaps a redesign, because something should be more available.

Ms. COUGHLIN. Absolutely.

Mr. CLINGER. You have recommended, and maybe you have answered this, that children under 40 pounds or 40 inches should be placed in the child restraint seat. Is that an arbitrary figure you've decided on or is there a scientific basis for that?

Ms. COUGHLIN. The short answer is that for uniformity's sake, the Board adopted 40 pounds and 40 inches. As a matter of record, most convertible seats (that is, those that can ride forward or backward in a car or plane) are manufactured up to the dimensions of 40 pounds and 40 inches. In 1983, when the Board did their child restraint study in automobiles, they used those dimensions and so for uniformity, we adopted those for the aviation recommendation as well.

Mr. CLINGER. Again, I thank you very much for your testimony before the committee.

Mr. OBERSTAR. Thank you. Mr. Laughlin.

Mr. LAUGHLIN. Thank you, Mr. Chairman. Ms. Coughlin, I travel with a brief case that is made of soft material and with what I carry in it, it probably weighs no more than 5 pounds. I wonder if you can explain the rationale of why airline flight attendants instruct me to put that under a seat rather than hold it in my lap or under my seat, or behind my legs in the seat, when they permit parents to hold a child that weighs more than my brief case. If my brief case gets knocked around, it is not going to sustain any injury to it or to me. Can you explain that rationale?

Ms. COUGHLIN. Well, I would first of all say that it is not the flight attendant that is requiring that you do that.

Mr. LAUGHLIN. She or he is following policy. My question is, why the policy?

Ms. COUGHLIN. It is inconsistent, Congressman. The reason that your brief case is under the seat, obviously, is that it becomes a missile in the air during unexpected turbulence, or in a crash situation, when there are G-forces beyond those in normal flight. It's an inconsistency. You have pointed that out. I have pointed that out in my testimony and I am sure that most people here today will point out that inconsistency. You are absolutely right.

Mr. LAUGHLIN. From a human viewpoint, the child or infant, in almost every instance is going to sustain injury in those very instances where the flight attendant is following FAA regulations to protect my brief case. Correct?

Ms. COUGHLIN. Yes, sir.

Mr. LAUGHLIN. Now, I must ask you how long has the FAA been studying this child/infant restraint injury problem?

Ms. COUGHLIN. Well, we certainly hope that they are at the end of the study process.

Mr. LAUGHLIN. I would like to ask my question again. How long has the FAA been studying this child/infant injury problem?

Ms. COUGHLIN. I think that is better addressed to the FAA. I can't tell you.

Mr. LAUGHLIN. I think I see some of them here.

Ms. COUGHLIN. I think you will have an opportunity.

Mr. LAUGHLIN. Too long, could you agree?

Ms. COUGHLIN. Yes, sir.

Mr. LAUGHLIN. With what little we have heard today, if they truly wanted to protect the traveling infant, they could have issued that rule a long time ago, couldn't they?

Ms. COUGHLIN. That is my view.

Mr. LAUGHLIN. If they wanted to be bipartisan, they probably could invite Mr. Lightfoot and myself down to help them write that rule. Couldn't they, Mr. Lightfoot?

Thank you very much.

Ms. COUGHLIN. Yes, sir. Thank you.

Mr. OBERSTAR. The gentleman from Iowa, Mr. Lightfoot.

Mr. LIGHTFOOT. Thank you, Mr. Chairman. Thank you, Ms. Coughlin and Ms. Marshall, for being here today.

As far as NTSB's involvement in the safety seat issue, the United crash, the Avianca crash, of course, I think brought this issue to national attention. Have you been involved in it prior to that? If so, how long and what have you been trying to do?

Ms. COUGHLIN. Yes, sir. The Board's involvement goes back to 1978, to an aviation accident that occurred in Portland, Oregon. I don't have the numbers in front of me, but my recollection is, and I was not on the Board at that time so it is a recollection and not an active involvement, was that there were six small children and six infants on board that plane. At least two or three infants were seriously injured and two or three infants died in that accident.

That was really the first time that the Board made a recommendation to the FAA. We did not at that point require safety seat use. It was like car safety seats at that point. It was a very new notion that we are better off restrained, that children were better off restrained, as were adults.

In any event, we did ask the FAA to go back and do some research as to what was the best method to protect children. In 1982 they came out with a technical standard that basically allowed four models of automobile child restraints to be carried on the aircraft. The Board came back in 1983 and asked them to go further, and to coordinate with the National Highway Traffic Safety Administration to come up with some common standards so that a car seat was not only approved by the NHTSA, but approved by the FAA as well. But again, they were not required.

The Board, I believe, came back again and in 1985 made additional recommendations and that brings us pretty much to where we are. The Board has long been an advocate of making their use mandatory and here we are today. We certainly hope we are getting closer to seeing that a reality.

Mr. LAUGHLIN. Is it a fair characterization that the relationship between NTSB and the FAA is, in essence, that NTSB is the safety expert? You do the investigations. You go out and try to determine why an airplane crashes. Then after your hearings and findings, these recommendations are passed on to FAA, who then usually follows through with some type of rule-making in the regulatory capacity to see that these safety recommendations are implemented. Is that a relatively fair characterization?

Ms. COUGHLIN. Yes, sir, it is. I think, though, in fairness to the FAA it would be probably inaccurate to say that they didn't help us in accident investigation. And though we might have the jurisdiction, or the lead, in accident investigation, the FAA has certainly been an important part of our efforts. I wouldn't want to leave the impression that they were totally uninvolved in accident investigation because they are. I would also say that, as you know, our recommendations are not mandatory. We do not have regulatory authority ourselves, so we do rely on the offices of the FAA to accomplish what we have recommended. Again, in fairness to the FAA, they are the most responsive agency.

Mr. LAUGHLIN. Well, I appreciate your saying that because I certainly did not want to minimize FAA's part in the investigation process because they do play a very vital role.

If, for example, you find a problem—let's not talk about people, let's talk about mechanical problems—a mechanical problem that has caused a crash or possibly caused an accident, or something of that nature, do you make a recommendation? Does that normally come down as some kind of an AD note or something of that nature, that the owner of the aircraft has to comply with? In most cases, do you find that the FAA goes along with your recommendations, maybe with some slight modifications, but follows your basic recommendation?

Ms. COUGHLIN. Yes, sir.

Mr. LAUGHLIN. In a relatively timely manner?

Ms. COUGHLIN. Yes, sir. The recommendations that the Board issues are divided into a number categories: emergency, urgent, priority. We try to be very realistic in putting time-tables on the recommendations. Those that we feel should implemented immediately we do issue as emergency recommendations, and can do that at any point in an accident investigation, whether it is the day of an accident, or a month later. As you know, the investigative process is somewhat lengthy. We would not have to wait an entire year, which is sometimes what it takes to do a very comprehensive major aviation accident investigation. We would not have to wait that length of time to make what we felt was an emergency or very imperative recommendation. I would have to say that the FAA has, for the most part, had a very cooperative and interactive relationship with us.

Mr. LAUGHLIN. Well, I think that is the only way it can work and work well. We certainly are not here to bash or trash the FAA or you either, for that matter. But it just seems like you have been working on it at the Board for what, ten years roughly? It seems like that is an inordinately long time to have any results.

Ms. COUGHLIN. It is.

Mr. LAUGHLIN. The crash in Sioux City, which happened roughly a year ago—the Chairman was, I believe, mentioning a moment ago, about the restraints and if it is a problem getting out of the aircraft. There was a youngster there whose mother was restrained who survived and walked away from the crash. Her youngster suffocated because they could not find him. Isn't that pretty conclusive evidence that had that youngster been in a seat, where he was supposed to be, he might be here today?

Ms. COUGHLIN. Yes, sir. I believe it is. I think that is the tragedy of what we are talking about, that there are circumstances where aviation crashes are survivable. We have come a long way in terms of the survivability of a crash. It is just regretful that we are not in a situation where infants and small children are afforded those same protections. I believe, though we don't know for certain, that that child would have survived. We have every reason to believe that he would have survived. The NTSB over time has investigated accident after accident after accident where we have seen that children have fared worse because they weren't restrained. We can't emphatically say that their lives will be saved, but we have evidence and we have documentation that shows that they have fared worse. We believe that the situation needs to be corrected.

Mr. LAUGHLIN. You know, if I could add to the very cogent remarks that the Chairman made earlier as far as cost/benefit is concerned. We talk about the level of technology in safety. If you turn on CNN most any day or late at night and watch the car races, you see automobiles crash into the wall at 150, 160, 170 miles an hour, catch on fire, go flying across the middle of the race track, and then the driver unsnaps the seat belt and gets out basically unscathed. I think we have living proof almost on a daily basis that technology-wise, we certainly can encapsulate people in a vehicle where they can survive some very dramatic situations. The problem we run into with the helmet law, because we ran into the same thing in Iowa and right across the border in Nebraska, is that the public does not like to be inconvenienced. So they are not going to put on a fireproof suit, a crash helmet, have a car with a roll bar cage inside of it, seat belts and shoulder harness; and in the case of sprint cars, actually having their arms strapped in so they won't flail outside when the car flips. They are not going to do that. That is where they draw the line. But is putting a child in a seat and snapping a belt, is that too much of an inconvenience?

Ms. **Coughlin**. I certainly don't think so.

Mr. **Laughlin**. Is your child worth $500? I will yield to the gentleman.

Mr. **Lightfoot**. There are consequences that you have to consider in every situation, if it is a question as to whether or not you are going to strap them in a bus, where restraints are not required, or a train, which does not require restraints, or an automobile, which is the single most dangerous way to travel. Those are all things that you wish to weigh. If placing them with a restraint is going to keep them from dying when they fly into a mountain, I'm for it. But if it doesn't, then strapping them into a car seat on week-ends or holidays on interstate highways is something that one has to weigh. It has to fit into the mix.

Mr. **Laughlin**. I appreciate the gentlemen's comments. I would only suggest that if you would review the video tape of the plane that crashed in Sioux City, I do not think I have ever seen a bus or a train go up in that kind of a fire ball. If a bus is traveling at 55 miles-per-hour, that is a whole lot slower than the speeds at which aircraft travel.

Just one final comment; you mentioned a minute ago the four people heading out for Disneyland who might not fly because of the cost of an extra ticket, but might drive instead. That family of four are those who support the idea that the cost of the ticket will prevent them from flying and they will travel by road instead, or some other means of ground transportation. Are those people telling us that once that child reaches the age of two, they will never fly? They will never go on an airplane, because they will have to buy a ticket?

Ms. **Coughlin**. That is exactly right.

Mr. **Laughlin**. I do not believe that.

Ms. **Coughlin**. I agree with you.

Mr. **Laughlin**. Thank you, Ms. Coughlin, I appreciate it

Thank you, Mr. Chairman.

Mr. **Oberstar**. The gentleman from Texas, Mr. Geren.

Mr. **Geren**. Thank you, Mr. Chairman.

I apologize that I didn't get to hear all of your testimony, but I do want to ask just one question that will explore one option that perhaps you've addressed.

As we all know, the takeoff and the landing, in addition to being the most dangerous part and the time when we need the restraint, is also the most distressing part for the baby, if you are transporting an infant. That's the time when the baby needs the comforting, if ever, in the course of a flight because of the problem with the ears or whatever. That's the most frightening time, the most distressing time.

I wonder if you have explored any options that would allow the child—we're talking about an infant, and perhaps you could have it 10 to 20 pounds treated a certain way, 20 to 40 pounds treated another way—but allow the infant to be restrained in the lap of the parent, such as a superreinforced "snuggly" is the thing that comes to my mind, because it would seem that that would solve the problem of the child becoming a projectile in the case of a crash or some sort of a sudden stop, and it would also allow the parent to comfort the infant. The drawbacks of that aren't readily apparent to me, and I wish you would respond to that.

Ms. COUGHLIN. There may well be an alternative that has not yet come to light. There may be some way to provide that sort of closeness between a parent and a child in an actual lap situation. What we do know is that that technology doesn't exist today, and looking at the situation as we know it today, we believe that despite the deprivation of attention from the parent during that stressful time, that child is better off restrained in a seat——

Mr. GEREN. Well, I'm, not suggesting that avoiding that distress is worth endangering the life of the child. Please don't get me wrong. But it doesn't seem to me that we're talking about "rocket scientist technology," particularly for a child that is 10 pounds or 12 pounds. It would seem to me that that child could be adequately restrained in the lap of a parent in something that—all we're talking about is the same kind of material that makes up the seat belt, that holds a 200-pound person in place.

Ms. COUGHLIN. Congressman, I'm not aware of technology that today has been tested enough that I would feel comfortable in endorsing it.

The one thing that does cross my mind is that as that parent started to assume the brace position himself or herself, having a child in a particularly bulky apparatus preventing them from taking the brace position might then put both the parent and the child at risk. It's just worth thinking about.

Mr. GEREN. Well, has it been investigated at all? Is this the first time that that's been raised?

Ms. MARSHALL. I think you can probably get more testimony from the FAA, but the Civil Aeromedical Institute in Oklahoma City has done testing of a device that is being used in Europe called the "Belly Belt." It's a small belt that attaches to the adult belt.

There are some very serious problems with having a lap child during an accident because the parent is going to come forward over the child and crush them. The CAMI studies have shown not only that the infant will have a great deal of pressure exerted on them, but that their head goes into the seat in front of them. I've only seen preliminary information on that, but perhaps Dr. Chandler could explain it further.

Also, currently—and these are present regulations—the Federal Motor Vehicle Standards that permit the use of child restraints do not allow for a device that is restraining both occupants. In cars, you don't have devices that are approved for a child and an adult, but it's the crashworthiness that comes into question in keeping a baby on your lap.

If the upper torso is restrained, you get a different situation.

Mr. GEREN. Well, my thought would be something like you have in a car, with a restraining belt across your chest and across your lap, and then the opportunity to somehow have a small infant restraint in your lap.

If it has not been investigated, it would seem to me that it ought to be explored, and perhaps the FAA has done it. But before jumping to the conclusion that we need to put a 9-pound baby in a car seat in a separate seat, it just seems to me that it's something that is worth someone's attention. The technology doesn't seem to me to be a problem. Whether or not it works is perhaps an issue that has not been addressed, but I don't see a problem with at least concocting the apparatus to see if it would work.

Ms. COUGHLIN. Apparently there is some research going on in that area, and—at least as I understand Ms. Marshall's comments—there are some difficulties that have not yet been overcome. But we will look at it.

Mr. GEREN. Yes, I would just urge that you do look at it and not just decide that this other is the answer, and not consider that there is an alternative.

Particularly, there is a difference between a 40-pound child and an 8-pound child.

Ms. COUGHLIN. Yes, sir. Absolutely. Quite frankly, Congressman, I think the Board would agree that if it was an FAA-approved device, we would go along with its use as conforming to the recommendation. As long as those children were restrained in an FAA-approved child restraint system appropriate to their size and weight, I don't believe the Board would have a problem endorsing that notion. But right now the apparatus that you are suggesting is not approved by the FAA, so we are basing our recommendation on what had been approved to this point.

But it is certainly something that we will keep in mind as research on the subject of occupant restraints develops.

Mr. GEREN. Well, thank you very much.

I have no further questions, Mr. Chairman.

Mr. OBERSTAR. Thank you.

The gentleman from Ohio, Mr. McEwen.

Mr. MCEWEN. Thank you, Mr. Chairman.

Have you considered requiring restraints on trains, for example?

Ms. COUGHLIN. Honestly, Congressman, I haven't been at the Board long enough to know if they have ever been recommended. I have not seen a recommendation requiring belts on trains, but faint recollection tells me that the Board might have made, one at one time, such a recommendation. Again, I would go back to the cost-benefit argument. I think there is a big difference, as we've pointed out, between the inertial load on an Amtrak train and the inertial loads on an aircraft. Obviously in such an accident—as flying into a mountain—obviously no restraint system is going to protect your life at that stage. But there are survivable accidents, and researchers have told us that at less than 20 Gs an accident is survivable. Yet we've seen children in accidents where there were less than 20 Gs, and even in minor accidents, where children were severely injured because they weren't restrained.

We've required them in automobiles——

Mr. McEwen. These were under age 2, the children you were referring to that were unrestrained?

Ms. Coughlin. Yes.

Where there were survivors——

Mr. McEwen. I read the FAA folders. You've submitted those studies that you're referring to in the testimony today?

Ms. Coughlin. I'm not sure which studies you're talking about.

Mr. McEwen. The ones you were just quoting that said that children were injured at less than 22 Gs that could have survived if——

Ms. Coughlin. Those were accident investigations that the Board conducted. In aviation accidents that we investigated we found accidents where there were fewer than 20 Gs of force involved in the load where there were children who died.

Mr. McEwen. And you've submitted that to the committee, or is it just that I haven't seen it?

Ms. Coughlin. We can submit it.

[Information received from Ms. Coughlin follows:]

Below is a list of survivable accidents in which children received injuries:

January 4, 1972.—a National Airlines B-747 encountered turbulence near Lake Charles, Louisiana. An unrestrained 6-month-old infant struck an overhead compartment and sustained a facial contusion.

December 28, 1978.—a United Airlines DC-8 crashed in Portland, Oregon. Among the passengers were six infants and six small children between the ages of 25 months and 8 years. Two infants and one child sustained fatal injuries.

July 13, 1986.—an Eastern Airlines A-300 encountered turbulence as it descended for landing at the Miami International Airport. The seat belt sign was on and the captain had made an announcement about expected turbulence. Of those on board, 20 passengers and 8 flight attendants sustained minor injuries, and 2 passengers sustained serious injuries. An unrestrained 7-month-old infant was propelled upward and fell on an armrests of the seat in front of the infant's parents. The infant sustained a minor injury: a contusion to the left temple.

November 15, 1987.—a Continental Airlines DC-9 crashed during takeoff from Denver, Colorado. Of those on board, 3 crewmembers and 25 passengers sustained fatal injuries. A 6-month-old in-lap infant died of multiple injuries from blunt force impact, including basilar skull fractures and injuries to the thorax.

July 19, 1989.—a United Airlines DC-10-10 crashed in Sioux City, Iowa during an attempted emergency landing. Of the 296 persons on board, 110 passengers and 1 flight attendant were fatally injured. One infant was fatally injured; two inflants and a small child sustained minor injuries.

January 20, 1990.—an American Airlines DC-10 encountered turbulence near San Juan, Puerto Rico. The seat belt sign was on. Preliminary investigation revealed that an unrestrained 7-week-old infant sustained serious head injuries and was hospitalized with a fractured occipital bone, subdural hemorrage, and intra-cranial bleeding. The infant was the only occupant who sustained serious injuries.

January 25, 1990.—an Avianca Airlines B-707 crashed in Cove Neck, New York, with 149 passengers and 9 crewmembers. Among the passengers were 7 infants under 2 years old. A 4-month-old infant sustained fatal injuries. The six other infants, who were between the ages of 4 months and 18 months, sustained serious injuries.

Mr. McEwen. What numbers are we talking about? How many children that were under age two where there were crashes that would have survived, that had they had seat belts on would have lived through an aircraft crash?

Ms. Coughlin. I don't have those numbers. Can we provide those for the record for you?

Mr. McEwen. I think it would be very, very helpful.

[Information received from Mr. McEwen follows:]

We are unable to respond because the Safety Board has not analyzed injuries associated with aviation fatalities.

Ms. Coughlin. The Safety Recommendation Letter, I'm told, actually discusses those numbers, and I do have a copy of that.

Mr. McEwen. For the record, that would be fine.

[The Safety Recommendation Letter follows:]

National Transportation Safety Board
Washington, D.C. 20594

Safety Recommendation

Date: May 30, 1990
In reply refer to: A-90-78 and -79

Honorable James B. Busey
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On July, 19, 1989, a McDonnell Douglas DC-10-10, operated by United Airlines as flight 232, en route from Denver, Colorado, to Chicago, Illinois, experienced an in-flight emergency following the fragmentation and separation of the No. 2 engine fan disk. The airplane crashed during an attempted emergency landing on runway 22 at Sioux Gateway Airport, Sioux City, Iowa.

During the ground impact sequence, the airplane separated into sections and portions burned. The center section of the airplane, which contained most of the passengers, came to rest inverted in a cornfield adjacent to runway 17 and 3,700 feet from the initial impact on runway 22. Of the 296 persons on board the airplane, 110 passengers and 1 flight attendant were fatally injured. Autopsies revealed that 35 passengers died of smoke inhalation, including 24 without traumatic blunt force injuries. The others who were fatally injured died of multiple injuries from blunt force impact. Of the remaining 185 persons on board, 47 sustained serious injuries, 125 sustained minor injuries, and 13 were not injured.

The Safety Board's continuing investigation of this accident has disclosed problems that affected the safety and survivability of infants 1/ and small children. Among the 285 passengers on board were 3 infants and 1 small child--ranging

---

1/ Definition of "infant" is not standard among transportation-related organizations: definitions vary based on different criteria including age, weight, and height. The National Highway Traffic Safety Administration defines an infant as under 1 year old and toddlers from 1 to 4 years old. The Society of Automotive Engineers' Aerospace Recommended Practice (ARP) 1469, "Restraint Device for Infants," refers to infants as under 20 pounds and/or too young to sit up; ARP 766A, "Restraint Device for Small Children," refers to children as being between 20 to 40 pounds. Throughout this letter, the term "infant" refers to aircraft occupants who have not reached their second birthday.

in age from 11 months to 26 months--who were being held by adults. One infant was fatally injured; two infants and the small child sustained minor injuries. The three who survived were located in "B Zone" where 91 percent of the occupants sustained minor injuries.

During the preparation for the emergency landing, parents were instructed to place their "infants" on the floor and to hold them there when the parent assumed the protective brace position. The four "in-lap occupants" were held on the floor by adults who occupied seats 11F, 12B, 14J, and 22E. Investigators do not know what happened to the 26-month-old child at 12B during the impact sequence. Investigators do know that the child sustained an abrasion to his left hand and that his father was not injured. The 11-month-old infant at seat 11F was pulled from her mother's grasp during the impact, and the parents were unable to find her when the airplane stopped. She was found by a passenger who re-entered the cabin when he heard a baby crying. The infant sustained an abrasion under her left eye; the mother was not injured.

The woman in 14J said there were two extremely hard impacts before the airplane rolled to the right. She stated, "My son flew up in the air and I managed to grab hold of him around the waist. He struck his head [on the side of the cabin wall] several times before the plane came to a stop and several times I had to pull him back into my arms as he slid out of my grip." Her 23-month-old son sustained a scalp contusion, and she sustained a contusion to her right ear.

The woman seated in 22E stated that she assumed the brace position with her 23-month-old son on the floor between her legs. During the impact, she was jolted to an upright position and she saw her son's body "flying" down the right aisle toward the rear of the cabin. When the airplane stopped, she could not get to the back of the cabin where she thought her son was. Smoke immediately entered the cabin and hindered her breathing; she was urged by other passengers to exit. She was not injured, but her son died of asphyxia secondary to smoke inhalation.

The problems experienced by these three parents graphically illustrate the impossibility of holding onto an infant during a crash. Present regulations of the Federal Aviation Administration (FAA) allow an occupant who has not reached his/her second birthday to be held in the arms of an adult. Researchers at the FAA's Civil Aeromedical Institute, however, have vividly demonstrated with anthropormorphic dummies of varying weights that holding onto an infant is difficult, even in accidents involving the minor inertia loads specified in 14 CFR 25.561.

The Safety Board is concerned that the FAA has not adequately addressed the issue of "infant" occupant protection. Investigations have repeatedly shown problems with the safety and survivability of unrestrained infants and small children who have been involved in survivable crashes or incidents in which turbulence was encountered. For example:

> On January 4, 1972, a National Airlines B-747 encountered turbulence near Lake Charles, Louisiana. An unrestrained 6-month-old infant struck an overhead compartment and sustained a facial contusion.
>
> On December 28, 1978, a United Airlines DC-8 crashed in Portland, Oregon. Among the passengers were six infants and six small children between the ages of 25 months and 8 years. Two infants and one child sustained fatal injuries. The Safety Board subsequently recommended that the FAA "expedite research with a view toward early rulemaking on a means to most effectively restrain infants and small children during in-flight upsets and survivable crash landings" (A-79-63).

In response to the recommendation, the FAA issued Technical Standard Order (TSO) C-100 in 1982, which provided for the use of some automobile infant restraint devices on airplanes. On February 24, 1983, the Safety Board issued Recommendation A-83-1 to the FAA to "Amend TSO C-100 to permit the use of any infant or child restraint device bearing a label in conformance with 49 CFR 571.213, S5.5.2 (e) during takeoff, landing, and in-flight operations, until such time as the Federal Aviation Administration and the National Highway Traffic Safety Administration issue standards for devices acceptable for use in both motor vehicles and aircraft." Recommendation A-83-1 superceded A-79-63.

In response to A-83-1, the FAA issued TSO C-100a in March 1985, which described child/infant seats acceptable for use aboard aircraft: those manufactured after February 26, 1985, that also complied with applicable Federal Motor Vehicle Safety Standards. Some seats manufactured prior to February 26, 1985, were also acceptable; those seats were listed in Advisory Circular (AC) 91-62, "Use of Child/Infant Seats in Aircraft," issued February 26, 1985. The circular provided information to assist air carriers on the proper use of child/infant seats aboard aircraft. The circular also made clear that the use of child/infant seats was not required by the FAA and that their use was at the discretion of the airline.

Since the amended TSO C-100a and AC 91-62 were made effective in 1985, the Safety Board completed investigations of two airplane accidents in which infants were on board:

> On July 13, 1986, an Eastern Airlines A-300 encountered turbulence as it descended for landing at the Miami International Airport. The seat belt sign was on and the captain had made an announcement about expected turbulence. Of those on board, 20 passengers and 8 flight attendants sustained minor injuries, and 2 passengers sustained serious injuries. An unrestrained 7-month-old infant was propelled upward and fell on an armrest of the seat in front of the infant's parents. The infant sustained a minor injury: a contusion to the left temple.
>
> On November 15, 1987, a Continental Airlines DC-9 crashed during takeoff from Denver, Colorado. Of those on board, 3 crewmembers and 25 passengers sustained fatal injuries. A 6-month-old in-lap infant died of multiple injuries from blunt force impact including basilar skull fractures and injuries to the thorax. His mother survived with serious injuries.

During the Safety Board's public hearing that convened October 30, 1989, in Sioux City, Iowa, the Air Transport Association (ATA) testified that its member air carriers would be encouraged to promote the use of child safety seats that are acceptable to the FAA on board carrier airplanes. ATA subsequently has been in contact with manufacturers of child safety seats to determine if the size of the child safety seats could be reduced to make them more compatible with aircraft passenger seats. On February 22, 1990, the ATA petitioned the Federal Aviation Administration to require the use of child safety seats on transport category airplanes.

In testimony at the public hearing, the FAA stated that a review of regulatory history had failed to identify the reason for permitting occupants who had not reached their second birthday to be held in the lap of an adult. The FAA also stated that about 1 percent of the passengers enplaned on U.S. air carriers hold infants. When the FAA witness was asked to identify the best way for parents to protect their infants, the witness stated that infants were best protected in "an FAA-approved infant/child restraint system that was properly installed in a seat." The FAA also testified that the agency was currently engaged in a rulemaking regarding infant restraint. The FAA issued a Notice of Proposed Rulemaking (NPRM) 90-6, "Miscellaneous Operational Amendments," on February 28, 1990; the Safety Board has reviewed the proposed rule, which would prohibit air carriers from denying the use of approved child safety seats, but not require that they be used. The Safety Board does not believe that voluntary use of child safety seats is an appropriate means of ensuring occupant safety.

The Safety Board is currently investigating two more accidents that involved the safety and survival of infants and small children:

> On January 20, 1990, an American Airlines DC-10 encountered turbulence near San Juan, Puerto Rico. The seat belt sign was on. Preliminary investigation revealed that an unrestrained 7-week-old infant sustained serious head injuries and was hospitalized with a fractured occipital bone, subdural hemorrage, and intra-cranial bleeding. The infant was the only occupant who sustained serious injuries.
>
> On January 25, 1990, an Avianca Airlines B-707 crashed in Cove Neck, New York, with 149 passengers and 9 crewmembers. Among the passengers were 7 infants under 2 years old. A 4-month-old infant sustained fatal injuries. The six other infants, who were between the ages of 4 months and 18 months, sustained serious injuries.

The Safety Board has found confusion among parents of infants regarding the use of child safety seats considered acceptable by the FAA. For example, all child safety seats manufactured after February 26, 1985, contain a label that states: "This restraint is certified for use in Motor Vehicles and Aircraft." Although the FAA has made available a brochure entitled "Child/Infant Safety Seats Acceptable for Use in Aircraft," few parents apparently are aware that the brochure encourages the use of child safety seats in aircraft. Further confusion exists because some air carriers permit the child safety seats to be occupied by small children and infants while other air carriers deny their use. Thus, in the case of connecting flights with different air carriers, a child safety seat might be allowed on one portion of the trip but not on another portion.

Confusion also exists among air carrier personnel about whether automobile child safety seats can be used: parents have sometimes been told that the FAA prohibits use of child safety seats even though the seats contain the label that states they can be used in aircraft, and some parents have been told that they can use the seats during flight, but not during takeoff and landing. Additional problems are encountered by airline personnel in determining the age of in-lap occupants. This problem was illustrated in the Sioux City accident when a 26-month-old child was carried as an in-lap infant. There was confusion among some passengers during the preparation for the emergency landing about which "infants" to place on the floor. The passenger in seat 17E stated that the woman next to him apparently considered, but then rejected, taking her 27-month-old son out of his seat (seat 17G) where he was secured by a lapbelt to place him on the floor in response to instructions given over the public address system. The 27-month-old boy remained secured in seat 17G by the lapbelt during the impact and was not injured. A 3-year-old was taken from seat 27D by her father who was in seat 27C and placed on the floor. Both the father and daughter died of smoke inhalation.

The Safety Board has long promoted the use of safety seats in automobiles and has vigorously endorsed legislation to require their use. Fortunately, all 50 States and the District of Columbia now have child passenger protection laws. Morbidity statistics clearly show that small children and infants who are properly restrained in a safety seat that is correctly installed in an automobile have far better protection from death and serious life-threatening injuries than children and infants who are not restrained.

The Safety Board believes that, in addition to the increased risk of injury or death, unrestrained occupants jeopardize the safety of other passengers. In its investigation of the DC-10 accident that occurred in Sioux City, Iowa, the Safety Board noted that the unrestrained infant who was killed weighed 35 pounds. The Safety Board believes that the unrestrained status represents a major contradiction in the FAA regulations that require all other "items of mass" such as carry-on baggage to be stowed for take-off and landing; persons younger than 2 years may be unrestrained and thus pose a threat to other passengers in the event of an accident or during an in-flight encounter with turbulence.

The FAA has permitted infants to be held during landing and takeoff because there was no method to adequately protect them from turbulence and crash impacts prior to the introduction of child safety seats. As early as January 1, 1981, however, the FAA recognized the benefits of child safety seats and encouraged their use on board aircraft. The Safety Board is disappointed that in spite of the FAA's own research, the demonstrated benefits of child safety seats in automobiles, and the availability of child safety seats acceptable to the FAA as early as 1981, the FAA has failed to require their use on aircraft and has even allowed airlines to deny their use.

FAA testimony at the public hearing in Sioux City, Iowa, indicates that the FAA arbitrarily selected 2 years as the age cutoff for the requirement for an occupant to be restrained; the selction was not based on scientific or empirical data. The Safety Board believes that the use of child safety seats should be required for children below the weight of 40 pounds and under the height of 40 inches. The Safety Board also believes that the FAA should conduct research to determine the size at which a child is adequately protected by aircraft seatbelts and, if needed, determine a method of restraining children who are too large for child restraint devices while too small for aircraft seatbelts. Infants and small children should be afforded equal or greater protection from death and injury during crash impacts and turbulence as afforded other persons on board commercial and general aviation aircraft.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

> Revise 14 CFR 91, 121 and 135 to require that all occupants be restrained during takeoff, landing, and turbulent conditions, and that all infants and small children below the weight of 40 pounds and under the height of 40 inches be restrained in an approved child restraint system appropriate to their height and weight. (Class II, Priority Action) (A-90-78)
>
> Conduct research to determine the adequacy of aircraft seatbelts to restrain children too large to use child safety seats and to develop some suitable means of providing adequate restraint for such children. (Class II, Priority Action) (A-90-79)

KOLSTAD, Chairman, COUGHLIN, Acting Vice Chairman, LAUBER, and BURNETT, Members, concurred in these recommendations.

James L. Kolstad

By: James L. Kolstad
Chairman

In response to the Committee's request, the Safety Board has reviewed the Apogee Research report entitled "An Impact Analysis of Requiring Child Safety Seats in Air Transportation." The Federal Aviation Administration (FAA) contracted for the study in support of its recent Notice of Proposed Rulemaking which sought comments on the use of child safety seats (CSS). Although the Safety Board does not have the resources to conduct cost benefit studies or to analyze such in-depth studies, examination of the study disclosed flaws in some of the assumptions that were made by Apogee in making its study. For example:

- Although the study assumes that lap-held children represent 1% of all commercial aircraft enplanements, the number of children under 2-years old who travel as "in-lap" passengers is unknown. Moreover, accident investigations have revealed that children over 2-years old travel improperly as "in-lap" passengers despite FAA regulations requiring all occupants who have reached their second birthday to occupy a seat and be secured with a seatbelt.

- The Safety Board does not agree with the data which is presented to demonstrate the effectiveness of the proper use of CSS in automobiles. Misuse of CSS, such as placing an infant under 20 pounds in a forward-facing position, is not accounted for in the statistics. The Safety Board disagrees with Apogee's assumption that the use of CSS in automobiles has been 50% effective. However, it is commonly accepted that rear facing CSS occupied by infants are 90% effective when properly used, and forward-facing CSS occupied by older children are 60-70% effective when properly used.

- The Board found several errors in the study's analysis of fatalities and injuries to children under 2 years old who are permitted to be held in the laps of an adult was in aviation accidents and incidents; probably because it was prepared by persons who had no knowledge of aircraft crashworthiness, kinematics, and injury mechanisms. Thus the study's basic assumptions, which are based on interpretations of accidents, must be viewed with skepticism. The most obvious error in the Apogee study was the incorrect assumption that the 6-month old infant who was killed in the DC-9 accident in Denver, Colorado, on November 15, 1987, was located in a "non-survivable" area of the airplane. The mother holding the infant (Seat 5C) and other passengers near her (Seats 5F, 6C, 6D, 6E, 6F, 7C, 7D, 7E, and 7F) all survived the accident.

- The study, although intended to address the problems of children under 2-years old ("infants"), included two accidents that involved children who were 2-years or older. In other accidents, children over 2-years were counted as "infants".

- The Apogee study reviewed only accidents in which there were survivors and these accidents were defined by Apogee as "survivable" accidents. There have been numerous instances in which persons survived an accident that was considered "non-survivable" or "partially survivable" depending upon damage to the aircraft. Whether persons survive is not the criteria used by the Safety Board to define whether an accident is survivable. Thus, the Safety Board believes that the sample of accidents examined by Apogee was not a valid sample to demonstrate the effectiveness of CSS.

Based on its initial review of the Apogee Research report, the Safety Board disagrees with some of the assumptions made and on which the report is based.

Mr. McEWEN. Thank you. I'm a big safety advocate, and I think if we can pass laws to keep people safe, I'm for it. But also if every time Government comes up with a good idea that overrides parent responsibility and we're going to pass laws telling them how to treat their children, I am also interested in how those kinds of judgments weigh upon parents. As you know, I have four under seven. I am married to a nine-year flight attendant. I am a former airline employee, and I am very familiar with this issue. I do know what happens, as our staff members and others around here will tell you, what happens when children are no longer two years old and it requires the parent to pay the full fare, and where they go and what their options are.

As we have seen the doubling in the number of people flying in the last 10 years with deregulation, and whether or not that kind of air travel is safe or not vis-a-vis the alternatives to young families and the impact that that will have on what young parents will do with small children, and what actual percentage are impacted by the number of crashes of airplanes crashing whereby young children under age two would have survived had they had a belt on—I am interested in what those percentages are.

One cannot drive on a weekend in America on an interstate highway with a family and not encounter an accident. It is virtually without exception. On a 4th of July weekend or on a Memorial Day, if you go anyplace at all for any extended period of time, somewhere or another you're going to encounter an accident. And that is the safety alternative that we're considering here.

Ms. COUGHLIN. I made the comment earlier that I don't mean to diminish the critical situation we have on our highways in terms of the number of deaths. At the same time, I made the comment and I do believe it's a valid one: as creative and as competitive as our airlines are today, I cannot believe that very many families will pay full fare or even half fare, and that there will be marketing schemes adopted and devised to help young parents.

I think the airlines are very sensitive to this. After all, if they were to lose a family of four because they were charging for the fifth, it would be their loss, and I think they'll be very creative with innovative ways to defray the cost. Though I share your concern about highway safety Congressman.

Mr. McEWEN. Thus far, they haven't. Thus far, they haven't. When children go from age two to two and a half—you ask a parent with a three- or four-year-old whether or not that has impacted on them. I think you will find out what the answer is. I can give you three or four in this room, and this person is one. It does make an impact, and the airlines have not been overly concerned about my dilemma that the twins turned from three, and they are now five. So it is something in the mix that we need to consider.

I will say this, that two weeks ago when we took the train to Harper's Ferry, every one of them hopped in their seat and said, "Where's the seat belt?" And the eight-year-old, being what she is, said, "Well, don't trains have wrecks, too?" I said—well, reading Amtrak and all the rest, I had no explanation for that.

So when the Transportation Safety Board that investigates these things comes in and says, "We want to say that that infant that you choose to carry that does cry during landing"—and as I say, four children in 38 months, so I've been through this and I know what it's like—and at that moment that they're going to be restrained in case they fly into a building, if it has a seat belt on, it's going to survive.

The idea of the National Transportation Safety Board—we get into that percentage of nuance vis-a-vis those on the Metroliner that, just the night before last, was derailed again outside Philadelphia, and not having those people strapped in is something that I find novel, at least.

Ms. COUGHLIN. We have not attempted to trade one mode of transportation off against the other. I don't argue with you that there are other transportation concerns out there.

In this instance, the Board was addressing aviation safety. No one is arguing that we're not better off restrained while we're on that airplane. But I hear your point.

Mr. MCEWEN. Thank you very much.

Thank you, Mr. Chairman.

Susan, it's always great to have you, and I appreciate your testimony.

Mr. OBERSTAR. The gentleman strikes a responsive chord, talking about that many children in that short a period of time and the difficulty of travel. And the point is well taken about travel on a train.

The gentleman from California, Mr. Packard.

Mr. PACKARD. Thank you, Mr. Chairman.

Are there restraint devices now, Ms. Coughlin, that are interadaptable to automobiles and airplanes?

Ms. COUGHLIN. Yes, sir. I believe in 1985, the FAA broadened the Technical Standard Order that originally allowed infant seats on aircraft, and broadened the number and types so that there was a common standard between the FAA seats and those that are approved by the National Highway Traffic Safety Administration. So the answer is yes, a parent can buy an approved car seat and feel certain they will be allowed to carry it on the plane and put their child in it and that it is also FAA-approved. They are interchangeable.

Mr. PACKARD. Again, I support the effort to better protect our traveling infants. I still have some concerns that a mother with an unruly child on the plane often cannot be controlled or properly cared for without taking that child into her arms.

I am also concerned about the fact that it could significantly deter the family's traveling together.

Ms. COUGHLIN. The Board's recommendation, Congressman, was for those critical phases of flight—takeoff, landing, and periods of turbulence. Our recommendation did not preclude, when the Captain had turned off the seat belt sign, that the parent would not be able to take that child out and provide the sort of closeness, again, that all children love and are sometimes comforted by, particularly when they are unruly.

But we were looking at the critical phases of flight, and I think that's where it's most critical.

Mr. PACKARD. Then the general feeling is that it would not curtail families traveling?

Ms. COUGHLIN. The Board was not concerned with cost-benefit.

Mr. **PACKARD**. Thank you very much.

Ms. **COUGHLIN**. Yes, sir.

Mr. **PACKARD**. Thank you.

Mr. **OBERSTAR**. Thank you very much for the time, the trouble, the effort that the NTSB has invested in this issue and for the very careful and thoughtful deliberations in bringing us to this point. We appreciate your splendid contribution.

Ms. **COUGHLIN**. Thank you very much, sir. We appreciate being here.

[Ms. Coughlin's prepared statement appears on page 299.]

Mr. **OBERSTAR**. The next witness is the ever-present heavy hitter for the FAA, the all-purpose blocking back. When they have a tough issue, they send Mr. Broderick up here. Whenever the FAA is afraid that the Administrator might get bloodied and bowed, Mr. Broderick is sent into the breech.

I say that with a smile, but I want that to appear in the record. They don't put smiles in the record.

We greatly appreciate your presence here today, Mr. Broderick. Thank you for your participation and for the contribution that the FAA has made to this very important issue.

We have your testimony. It will appear in full in the record. You may summarize, if you choose.

TESTIMONY OF ANTHONY J. BRODERICK, ASSOCIATE ADMINISTRATOR FOR REGULATION AND CERTIFICATION, FEDERAL AVIATION ADMINISTRATION

Mr. **BRODERICK**. Thank you, Mr. Chairman. I appreciate the kind remarks.

I am pleased to have the opportunity to appear before the subcommittee today to provide the Federal Aviation Administration's views on H.R. 4025, which is currently pending before the subcommittee.

H.R. 4025 would mandate the use of child safety seats in air transportation. We applaud the safety concerns that underlie H.R. 4025 but are opposed to its enactment because mandating the use of child safety seats would lead to more lives lost than saved, and to more disabling injuries than avoided.

At the outset, I want to make clear that the use of approved child safety seats for infants provides a greater level of safety in the event of an airplane crash. Parents should be aware that the use of a child safety seat can increase the likelihood of their child surviving a crash which is otherwise survivable. There should be no debate about that point, nor should there be any question about whether the FAA believes that child safety seats should be used. We do We strongly encourage parents to use approved safety seats for their children.

We cannot support, however, the requirement in H.R. 4025 that the use of child safety seats be made mandatory. Our concern is that, while the chance of survival aboard an airplane may be slightly improved, the costs associated with mandating the carriage of a child in a separate seat will divert a significant number of families from our safest form of transportation—air travel—to the far less safe travel by automobile.

Simply stated, we believe that more people would die each year as the result of the enactment of H.R. 4025 than would be saved by its provisions. This concern has been reinforced by four separate studies which have been performed by outside organizations, and which I shall make available for the record.

[The studies referred to are as follows:]

USE OF CHILD RESTRAINTS IN AIRCRAFT—STUDIES THAT ARE BEING CONSIDERED BY THE FAA IN MAKING A DECISION

1. Richard B. McKenzie and Dwight R. Lee, "Ending the Free Ride of Children on Airplanes: A Myopic Method of Saving Infants' Lives." Submitted to FAA Docket No. 26142 by the Competitive Enterprise Institute. (See p. 135.)
2. Richard B. McKenzie and John T. Warner, "The Impact of Airline Deregulation on Highway Safety." Submitted to FAA Docket No. 26142 by the Competitive Enterprise Institute. (See p. 145.)
3. Robert J. Windle and Martin E. Dresner, College of Business and Management, University of Maryland, "Mandatory Child Safety Seats in Air Transport: Do They Save Lives?" Submitted to FAA Docket No. 26142 by Drs. Windle and Dresner. (See p. 188.)
4. Apogee Research, Inc., "An Impact Analysis of Requiring Child Safety Seats in Air Transportation," Draft, June 4, 1990. Study conducted for the FAA under contract. (See p. 210.)

Mr. **BRODERICK**. Let me elaborate.

We believe that passengers would be diverted to automobile travel since it would be extraordinarily expensive for consumers if child safety seat use were mandated. Unlike the costs of the Collision Avoidance Systems or windshear detection systems or aging aircraft modifications, the costs of mandated safety seats would not be imposed on the airlines to be accepted as a cost of doing business or to be distributed as a modest price increase among passengers generally. Instead, the cost of requiring safety seats would be borne by a select group, the families of infants. One study projects that cost to be an average of $185 per child, amounting to about $250 million each year. The 100 percent use of child safety seats would save approximately one life aboard an aircraft over a 10-year period, at a potential cost of $2.5 billion to children's families, according to that study.

In our view and in the view of others who have assessed this issue, a significant number of families who would have flown will elect to travel by automobile instead, leading to a greater risk of death not only to the children, who are the intended beneficiaries of H.R. 4025, but to their parents and brothers and sisters who will be in the automobile with them. A December 1987 study by Richard B. McKenzie and John Warner entitled "The Impact of Airline Deregulation on Highway Safety" found that the lower costs of airfares resulting from deregulation had improved highway safety by encouraging more people to fly rather than to drive. The converse would appear to be equally true: increased costs can divert passengers from airplanes back to the highways.

Dick Smith, Chairman of the Australian Civil Aeronautics Authority, in a June 6, 1989 article entitled "You'll Live Longer in the Air," which was published in the Australian periodical "The Bulletin," says, "the figures show that all forms of paid air travel are safer than traveling by car, varying from about twice as safe if you have chartered a small plane, to five times as safe in a small commuter aircraft, to 400 times safer with the airlines. After a study of the safety comparisons between air and road, it is fair to ask why there seems to be so little concern about road safety." Of course, he was talking about Australia.

A study performed by Apogee Research, Incorporated, on behalf of the FAA finds that "the required use of child safety seats will decrease the expected number of infant fatalities in air transportation, but increase the expected number of infant and non-infant family member fatalities, as some families switch to automobiles for travel." The study also concludes that, in the first year of implementation of mandated safety seats, the deaths of those who would be diverted to automobiles would be 20 times greater than the potential lives saved aboard aircraft through safety seat use.

Richard B. McKenzie and Dwight R. Lee, who serve as adjunct fellows at the Center for the Study of American Business at Washington University in St. Louis, also researched the effect of mandating the use of child safety seats.

Professors McKenzie and Lee observe that those who support a rule change requiring the use of child safety seats "are understandably concerned about the safety of traveling children." They go on to note, however, that such a mandatory requirement, if adopted, "could have precisely the opposite effect of the one intended. The rule change could increase the travel injuries and deaths of infants and toddlers and their parents and siblings. These perverse results would likely occur because the rule change would drive up the cost of travel by air and drive many families back to the nation's highways. And car travel remains far more dangerous, at least 30 times more so in terms of death rate per mile traveled for all travelers, parents and children alike, than air travel by all scheduled, large and commuter, airlines."

Using what they believe to be "reasonably conservative" assumptions, Professors McKenzie and Lee find that the shift to automobile travel caused by higher fares to families of children,

> * * * could translate into more than 1,600 additional automotive accidents each year, and the increase in accidents could result in more than 175 additional disabling injuries and just under five additional deaths each year. If the fare increase is much greater than the FAA conservatively assumes, the increase in highway injuries and deaths would, of course, be greater.

They further point out that,

> An unknown number of the victims will surely be infants who would have traveled quite safely on their parents' laps in airplanes. However, many of the automotive victims will be the infants' parents, brothers, and sisters, but many will also be travelers who had never contemplated air travel as an alternative means of transportation. They just happened to be at the wrong time on the nation's roads, made marginally more congested by the infant seat requirement.

Professors McKenzie and Lee conclude in their research paper that as a consequence of requiring child safety seats,

> The resulting increase in automotive deaths, although quite small, could easily be several times—quite possibly more than 35 times—the reduction in airline deaths. Congress and the FAA should not be in the business of creating a travel safety problem that is bigger than the one being solved.

Professors Robert J. Windle and Martin E. Dresner of the College of Business and Management of the University of Maryland also examined the issue of requiring child safety seats in an April, 1990 paper entitled, "Mandatory Child Safety Seats in Air Transport: Do They Save Lives?"

(See p. 188.)

Their model considered a variety of possibilities, ranging from different percentages of passengers who would be diverted to automobile travel to varying trip lengths on the road. Using the average auto fatality rate, under virtually every scenario more lives would be lost by mandating child safety seats.

Only with the most conservative assumptions—that only 10 percent of passengers would be diverted to automobiles; that automobile trip lengths replacing airplane travel would average only 77 miles—did the lives lost due to diversion not exceed the lives that would be saved on airplanes. Even in this case, the researchers cautioned against mandating child safety seats, observing that:

> It would be better not to change the regulatory system from an injury point of view. Using data from the Statistical Abstract of the United States, it is clear that whereas in air transportation the injury rate is only one-half the death rate, in automobile transportation the injury rate is 39 times the death rate. From an injury point of view, air transport has an even greater safety advantage over auto transport than from a fatality viewpoint.

Professors Windle and Dresner note that:

> The conclusions for this analysis are clear: mandating the use of child safety seats will result in an increase in fatalities, given the assumptions of the paper, and given almost all of the scenarios discussed. Air passengers will be diverted to auto travel, and given auto travel's poorer safety record, more travelers will die in fatal accidents. Even when it is assumed that tickets for children under two will be given away for free, enough traffic will be diverted from the airways to the highways to increase the fatality total. Only under unrealistically favorable assumptions—all travel on interstate highways, very low diversion rates, and very low trip lengths—will the safety seats even come close to saving as many lives in the air as they cost in lives to diverted auto traffic.

In closing, Mr. Chairman, I would like to reemphasize that parents who travel on aircraft with small children should use an approved safety seat for their children. There is no question but that the use of a safety seat will improve their child's chance of surviving an accident. Despite the safety benefit associated with use of a child safety seat, however, we cannot in good conscience support legislation that would mandate the use of child safety seats in view of the research which demonstrates that to do so would result in greater numbers of travelers' deaths. Although the studies differ in terms of numbers of fatalities to be expected, based on different assumptions they have used, all project that there would be additional deaths from requiring safety seats.

As the subcommittee knows, we are currently involved in a rulemaking process that has sought public comment on alternative approaches to this issue, and we are giving it a high priority.

That completes my prepared statement, Mr. Chairman. I would be pleased to respond to questions from you or the members of the subcommittee.

Mr. OBERSTAR. Thank you very much, Mr. Broderick. I will be relatively brief, and that may be a mercy. There are two things that I want to focus on.

First of all, the cornerstone of the FAA's testimony is the assumption that parents will choose to drive rather than fly because of the cost of putting a child in a paying seat. But that cost-benefit analysis that was done is only on the side of cost.

Did the FAA undertake any efforts with the air carriers to engage in a dialogue about options that the carriers might consider? If FAA is going to be in the business of doing cost-benefit analyses on safety issues, then did the FAA undertake efforts to determine whether there are ways of mitigating the costs in order to maximize the benefits? In short, did you ask them, "Would you consider a reduced fare for a child"—and I'm going to ask the same question of the ATA—"Would you consider the possibility of a reduced fare, share the burden of cost with the family, to have that child safe in a seat in case of turbulence and in case of a crash?"

Mr. BRODERICK. Mr. Chairman, the FAA did not do anything in a formal sense, but I can tell you that I have personally have done a lot of questioning of senior airline officials from the major airlines. They all urged that we allow the marketplace to do that. They have said what people favoring child safety seats have argued, that they will perhaps use promotional fares and that kind of thing to give discounts to urge people who have infants to come on the airplane. But they have made it very clear that they do not look favorably on any kind of legislation—none of which is on the books, of course—that would require them to in any way cap the fares. They would prefer to let the market decide what the fare should be for infants.

Mr. OBERSTAR. I certainly think the market ought to do that. There ought to be a leader willing to take that cause up and advocate an attractive fare to keep families together, on board aircraft, off the highways, if indeed the assumption is right that air travel is safer than highway travel. If we would be doing a disservice to families by driving them from aircraft onto a less safe mode of travel, then the carriers ought to share some of that burden, and the FAA ought not to be in the uncomfortable position of doing cost-benefit analysis of safety matters.

Mr. BRODERICK. Mr. Chairman, I agree with what you've said. Let me just add that it is clear that so far, the airlines have not taken advantage of the opportunity which currently exists to do that. They have in fact, as you know, petitioned the FAA that we mandate something, which they are individually or all together free to do now, and that is mandate the use of child safety seats.

I see no reason, if airlines intended to act like you just espoused the hope that they would, and I share that hope, that they wouldn't have done it already.

Mr. OBERSTAR. Well, I'm certainly going to give the air carriers an opportunity to show their bona fides on this matter. I invited one carrier some years ago to be a leader in the industry and ban smoking on all its flights, and the President and Chairman of the Board demurred at the time and said, "Oh, we might lose a few passengers." A year later, having thought it over, they became the leader in the industry. They lost an advertising agency—or an advertising agency lost a client, I think, because one of its smoking clients chose not to use that advertising agency—but I think they picked up a lot of passengers, and they saved a whole lot of money on the maintenance of the aircraft by stopping smoking.

There are some benefits if they will just show a little courage by stepping forth, and I'd like to see one of the carriers come forward and say, "We want you, families, to stay together and fly safely. We'll share the cost with you; in fact, we'll pick up a little bit of that cost." Because they're not just buying one family on one flight. They're going to get that family and that living child for perhaps a lifetime of flying.

FAA did cost-benefit analyses on smoke hoods and decided that it wouldn't require smoke hoods on aircraft. That's a far less cost, and a very considerable saving of life that could be undertaken. FAA dragged its feet for a very long time on floor proximity lighting on board aircraft, finally moved on it, pushed the manufacturers, and now that's on board aircraft. There are a number of other redundant systems on board aircraft that the FAA has required in the interest of safety without having done great, huge cost-benefit analyses and saying, "These are going to drive passengers off aircraft, because putting two auxiliary power units or three thrust reversers on aircraft is going to jack fares up and people won't fly."

I just have to believe that the professionals in the FAA, who are the premier line of safety in aviation in the world, have to feel uncomfortable being in the position of doing cost-benefit analyses that measure life against cost.

Mr. BRODERICK. Mr. Chairman, if I might, let me expand a little on your comments.

Mr. OBERSTAR. Please do.

Mr. BRODERICK. Every one of those safety improvements that you mentioned is something whose cost is borne by the passengers in general, and generally speaking, it's a one-time cost.

The particular legislation that we're talking about now would also impose a cost. We estimate that cost, taking into account all discounts, trip lengths, and everything else, to be about $185. But instead of spreading the cost over the entire aircraft, it would focus only on the families of the infants.

Mr. Chairman, if we raise the cost of everyone's ticket by the same percentage that we are talking about for the families with infants, you would be talking about an annual airline fare increase of some $10 billion to $20 billion. No one would debate that that would have an enormous——

Mr. OBERSTAR. You say $10 billion to $20 billion?

Mr. BRODERICK. Billion, with a B.

No one would debate that that kind of thing would have an enormous impact on the number of people traveling, a negative impact on travelers by air. It's the same kind of impact that we're talking about, but only on the families with infants that they must bear. And that's why that small group of people—we estimate that 4 million infants a year travel by air—that tiny group of people has to bear the entire burden of this. And for them individually, as Mr. McEwen indicated from personal experience, as I've had and as you've had, that is a very, very large burden for working people.

Mr. OBERSTAR. There's no question that there is an additional cost. I think that if the FAA is in the position of being required to undertake a cost-benefit analysis, then it ought to be officially in the business. I expect that you have informally pursued that matter, because I know you're an advocate for safety, but I think that the agency ought to officially and formally pursue means of engaging the carriers in discount fares that attract families rather than keep them off aircraft.

Mr. BRODERICK. Mr. Chairman, if I might, I would like to demur a little bit on the issue of cost-benefit. When we talk about dollars versus lives, that's not what I'm talking about here. Cost is only the reason that what happens, happens. We look at this, as you have heard in my statement, as a question of lives saved in airplane accidents versus lives lost on the road.

We must consider the impact to all of society of any regulation that we issue. Never before have we had a regulation that had such a diversionary impact as this one. The sum total of all of the regulations that you cited as safety advances didn't have that kind of an impact if you add it all up over the whole decade, that this rule would have in just one year.

It is a very, very large balance of lives saved versus lives lost. I'm not talking about dollars. I'm talking about saving lives in airplanes versus losing them on the highway.

Mr. **Oberstar**. Thank you. As I said at the outset, the FAA's very thoughtful analysis of this issue gives me pause. You have summarized some very significant factors there. Given the source, they have to be very carefully considered.

I do want to admonish myself and all members that we need to adhere as closely as we can to a five-minute rule if we're going to get through all the witnesses today.

The Chair recognizes the gentleman from Pennsylvania.

Mr. **Clinger**. Thank you very much, Mr. Chairman.

Mr. Broderick, shouldn't we maybe just trust the free market system? If in fact the imposition of this rule would result in massive defections of families to other modes of transportation, couldn't we make a presumption that the airlines are going to do something about that? I mean, they're not going to want to see a tremendous loss of patronage of their airline because of this, and would make some accommodations to perhaps attract those people back or keep them on board.

Mr. **Broderick**. I'm not a marketing expert, Mr. Clinger, but I can tell you that our study has carefully considered that.

The additional cost to the families with infants is estimated by one study to be about $250 million a year. The additional revenue that would come to the airlines if we accepted their petition and did as they asked, or if this legislation were passed, would be $120 million a year. In other words, economically, it's a good deal. You lose a few passengers, but those families that remain with infants pay more. The net is a positive inflow that we calculated in the decade of the 1990s to be about $1.2 billion.

Airlines aren't interested in maximizing passengers. They are interested in maximizing revenue. And of course, they're a business, so they're interested in maximizing profits. That's good. If in fact you can maximize profits or increase profits by encouraging more people to travel, that's one thing you might do, but it isn't absolutely unreasonable in a market sense—and there are others who will testify today who know much more about economics than I do—but it just makes plain sense to me if you can improve your revenues by raising prices, that's not a bad deal.

So what I'm saying is that it's not obvious that the airlines are going to want to recover those passengers if the revenue situation does what the study done for us says it will do. What would happen then is that people would be diverted from air travel onto highways, and more deaths would occur on the highways than would be saved in the air.

Mr. CLINGER. I guess that's the thing I want to focus on now, the procedure that was used in those studies. What were the procedures? Were there actual interviews done with people? "What would you do in the event these things were raised, or this was required? Would you then travel by car?" Or was this basically sort of an economic model that determined that this in fact would follow?

Mr. BRODERICK. There are four studies that I referred to, only one of which was even sponsored at all by the FAA. All of them generally agree, and they are models. They are economic models which have relatively good acceptance. What you have to do is judge what you think the validity is of the assumptions that they make. But the key thing, certainly, in Professor Dresner's study that he will talk about later on, is that over the widest range of assumptions—even if our study is off by a factor of 10, a thousand percent, you still lose more lives on the road than you would gain in the air.

Mr. CLINGER. Did they opt to discover other modes?

Mr. BRODERICK. They have to estimate how many people would actually travel, and of course, not all traveled. Only a fraction of the people who didn't travel by air took a trip by car. Those, obviously, were the shorter trips. They broke it down into trip lengths and did quite a good job of making an analysis of it. I don't think that the bus travel or train travel is significant enough percentagewise to enter into the equation.

Mr. CLINGER. You know, I think if we followed through with the FAA's reasoning to its logical conclusion, and if in fact we wanted to do everything we could to encourage the safest form of travel, perhaps we could mandate lower air fares across the board to encourage people to forsake the automobile and travel by air. I mean, should we really be intruding into the system to that extent? If we're trying to play God here and save lives, that certainly would be one way in which we could do it.

Mr. BRODERICK. I could give two answers to that.

One, if the Government could figure out a system where it could demand that the prices go down and the system would still work very efficiently and there would be no problems, that might be reasonable. But that's not the question that we were addressing. We were addressing a question of what would happen if this piece of legislation were enacted. It would mandate the use of child restraints. We did an analysis of the safety effects of the legislation, and it turns out for the first time ever that I know of on a serious proposal, we found that the safety benefits in the air would be greatly outweighed by the lives lost on the highways due to diversion of traffic. And I stress that this is a unique situation. It has never happened before in my memory, and I can't conceive of a situation where it would, except in this kind of a situation.

Mr. CLINGER. Well, I want to thank you again very much for your testimony.

Thank you, Mr. Chairman.

Mr. OBERSTAR. Mr. Laughlin.

Mr. LAUGHLIN. Thank you, Mr. Chairman.

Good afternoon, Mr. Broderick.

In making the study that caused your agency to make the decision that it has made on this legislation, I was wondering if you determined the number of parents who are traveling, and the number of infants two years of age or younger who are traveling, when you reached this $250 million figure that you have given us in this testimony.

Mr. **Broderick**. The contractor that did this study estimated that there are about four million infants under two years old that are enplaned annually, and then the family that goes with them is, I believe, a little more than two additional people, sir.

Mr. **Laughlin**. Did your contractor determine whether in most instances, or very rarely, the parents traveling with the infants less than two years of age travel on the reduced fares; where they planned their trip so they would leave before midnight and arrive after Saturday, and all the wrinkles that the airlines do to get the reduced fare?

Mr. **Broderick**. Mr. Laughlin, I know that they very carefully considered all of the information available, and the $185 average ticket price increase takes into account, to the best of their ability, all of the factors of discounts and off peak and super saver and all that kind of thing.

Mr. **Laughlin**. Let me ask my question more directly.

Did you find that most of the time, parents traveling with infants travel on reduced fares where they have scheduled their trip, rather than just showing up at the airport and paying full fare?

Mr. **Broderick**. Mr. Laughlin, I don't recall, but I think that that is in fact true, and I believe that the study reflects that.

Mr. **Laughlin**. Did you or any of the people at the FAA ever enter into any dialogue with airline executives to determine that if this child restraint was required or made mandatory, that the same free travel that they are offering today without child restraint would be offered if the parent traveled with that infant during off peak hours?

Mr. **Broderick**. I don't recall exactly the way I answered the question, but as I indicated to the Chairman earlier, I personally engaged in a number of discussions with senior airline executives, asking them about what they would do. Their answer was that basically they would prefer to let the market run its course, and they would of course use the kind of promotional things you talked about.

But specifically on that issue, I don't think I framed the question the way you did, sir.

Mr. **Laughlin**. One of the missions of the FAA, as I understand it, is passenger safety.

Mr. **Broderick**. That is our most important mission, sir.

Mr. **Laughlin**. And in that connection, you do not let the marketplace determine whether you have flight attendants aboard the commercial domestic flights, do you?

Mr. **Broderick**. That is correct, sir. We don't.

Mr. **Laughlin**. You do not let the marketplace determine whether you put oxygen facilities and masks on board your commercial airlines operating under your jurisdiction that fly above a certain altitude, do you?

Mr. **Broderick**. No, sir, we don't.

Mr. **Laughlin**. Then I have trouble with your position and the FAA's position of good conscience in opposing this safety legislation when you have not entered into clear dialogue with the commercial airline executives, whether they would offer the option of off-peak-hour, free travel for safety.

I have problems with the good conscience of your agency when you have flight attendants, who are very vital to the safety of the passengers, but you do not let the marketplace determine that feature, and many other features that members of this panel have covered with you.

So I want you to leave knowing that this Member has difficulty on this issue with the good conscience of your agency.

Then I want to ask you, how long has it been that the FAA has been studying the rulemaking on child restraint?

Mr. **Broderick**. I heard you ask the question earlier, sir.

The very first regulation that we issued dealing with child restraint was in 1981. We also updated it, as you heard from Ms. Coughlin, in 1985. The first study that we ever did on child restraint, I believe, was in 1959. But we are not currently studying, as the word you used, the use of child restraints, but for comment on this legislation and but for the petition from the airlines that we mandate the use of child restraints.

Mr. **Laughlin**. I wonder if you have the same problem with the inconsistency that Ms. Coughlin and I have about my inability to hold my soft briefcase, weighing less than five pounds, either in my lap or behind my legs with the seat as the other side of the restraint, when we permit parents to hold a 15- or 20-pound infant who can become a missile or projectile in accident situations.

Mr. **Broderick**. I'd be happy to explain that, sir.

Mr. **Laughlin**. Please do.

Mr. **Broderick**. Storing luggage, using flight attendants, having safety improvements all improve airline safety and are not outweighed by lives lost on the road. Everything that you mentioned, everything that the Chairman has mentioned, and every safety improvement that we have ever issued a requirement for improves the net safety of the traveling public—not only in the air, but it does not have an outweighed effect by lives lost on the ground.

The problem with this regulation is that only certain families, a tiny percentage of the families that travel, have to bear the entire cost. It would cause some of them not to travel by air; not all of them, but some of them not to travel by air. And when all is said and done, it comes down to a fairly simple weighing of benefits of a safety improvement, whether it's flight attendants or child safety seats, and lives lost on the highway as a result mandating that improvement. This is the only time in all of the safety regulatory analyses I've ever seen where, when you run that equation, you lose more lives on the highway than you would gain by the safety improvement in the air. It's just not a good thing for public safety, according to every study that we've seen.

Mr. **Laughlin**. Mr. Broderick, does your contract study indicate that parents would travel on the road if they were required to use the child restraint; if the airlines were to offer them off-peak, free travel just as they do if they hold the child in their lap?

Mr. **Broderick**. Our study didn't directly address that, but I think one of the studies that I mentioned earlier did address the issue.

I do think that's something that the airlines ought to do. I would like to see, as I discussed with the Chairman, the airlines figure out a way to encourage what they can do right now: encourage the use of child restraints by parents, as we do, and make it easy for parents—not hard, not confusing, but make it easy for parents to use child restraints, and advertise the fact that they can do that free during off peak hours.

I would do anything that we could to foster that kind of a policy on the part of the airlines.

Mr. **Laughlin**. Do you agree with testimony that we heard earlier that most parents do not appreciate the safety features used when an infant is being held in the parent's hands during an accident on an aircraft?

Mr. **Broderick**. Sadly, sir, I think that's true. Only 45 percent of the people traveling on the highways use seat belts today.

Mr. **Laughlin**. Has the FAA undertaken any course of action to educate travelers and parents of the safety problems of holding children in their laps?

Mr. **Broderick**. Yes, we do, sir. I'm afraid we're not the world's best PR agency, but we have printed brochures that, as soon as we have completed our rulemaking, will eliminate the confusion that the Safety Board referred to about whether or not you can use child seats. We will reprint that brochure and have it widely distributed and encourage the airlines to stuff the ticket folders with it.

Mr. **Laughlin**. I detect from the Chairman's moving about that my time is up, so I would close by saying to you, Mr. Broderick, I hope the FAA finds the courage that your agency has demonstrated on many occasions in the past to do the right thing. After this hearing has concluded, I hope you will find that the action that Mr. Lightfoot is asking for in his legislation; that your agency can find the courage to work with the domestic airlines in finding ways for traveling parents to travel more safely with their children.

If you find that courage at the FAA, I think you will be heroes to the traveling public. Thank you very much.

Thank you, Mr. Chairman.

Mr. **Oberstar**. Mr. Lightfoot.

Mr. **Lightfoot**. Thank you, Mr. Chairman.

I heard the bell there, so we'll have an automatic five-minute timer on this one.

Mr. Broderick, you cited a number of studies and surveys and so on. Am I correct, the Apogee cost-benefit study is the one that you commissioned at the FAA?

Mr. **Broderick**. Yes. It's actually an impact analysis, sir, not a cost-benefit study. But yes, that's correct.

Mr. **Lightfoot**. How many of my tax dollars did you spend on this study?

Mr. **Broderick**. I don't know, but I can supply it for the record. It was a fairly short study.

Mr. **Lightfoot**. I would appreciate it if you would

[Information received from Mr. Broderick follows:]

The total cost for the Apogee impact analysis on the use of child restraint systems was $63,325.

Mr. Lightfoot. One of the things that is predominant through all of your testimony, through all of the studies that you gave to us today, is the word "assumption." All of these are assumptions that certain things will happen, that certain people will react certain ways, and so on, and I guess it troubles me that for the 20-some-odd years that I've been in aviation, looking at proposed rulemakings, never once have I heard the FAA cite auto safety for a reason for a rule that applies to aviation, and then suddenly we have this overriding concern over automobile safety based on a bunch of assumptions.

For example, the Apogee study says that the airlines are going to charge 80 percent of adult fare or half of full coach. Why would they do that? They don't charge for kids under two years of age today. Where do we come up with the number of laps or the number of children that are unrestrained on airlines? I've talked to the airlines. I can't get a good, solid figure. They estimate anywhere from maybe 5,000 to maybe 10,000 kids a day that possibly are riding free of charge.

I guess what I'm getting to is that the data I think is being used in these studies—although I wouldn't for a moment question the integrity or the intentions of these people—I think we're dealing with a situation where we don't have good, solid data to make these assumptions from. We're making an assumption to start with, to make an assumption from that, and then we come up with these huge dollar figures and so on that almost sound like a scare tactic. That's what troubles me, that the FAA at this point is so vigorously defending highway safety based upon a bunch of assumptions on assumptions which no one really can validate.

Mr. Broderick. Mr. Lightfoot, I think Professor Dresner can address that from his study that he submitted to the docket, unsolicited by the FAA. He varied all of those assumptions and comes up with—almost any scenario he puts forth—you exceed the lives saved in airplanes by deaths on highways.

As I said earlier, even if our assumptions are off by 1,000 percent, we still calculate that the number of lives lost on the highway would be twice the number of lives saved in the aircraft.

Mr. Lightfoot. You mentioned Professor Dresner, and we're going to get a chance to talk to him. But let me quote from your statement: "Even when it is assumed that tickets for children under two will be given away free, enough traffic will be diverted from the airways to the highways to increase the fatality total."

Why in the world are people going to travel on the highway if they're getting the tickets free? And this totally contradicts page 34 on the Apogee study.

The point I'm trying to make is this. I think we're using a number of studies—again, well-intended—but we're making a lot of assumptions, and that in my opinion is a lot worse than trying to predict what the weather is, in this whole situation.

I'm about to run out of time. Let me very quickly go to a couple of other very quick questions.

I guess I wonder to a great degree why, back in the original rulemaking days, when it was determined that adults should be restrained on aircraft, flight attendants have to be strapped down during takeoff and landing, and even occasionally when you hit turbulent air the pilot will have them go sit down and fasten their seat belts—back in the very beginning when all this rulemaking came about, why children under the age of two were exempted at that point in time. I will give you two questions here, so you can answer both of them.

That appears to be discriminatory against youngsters under age two.

I also would like your opinion on the idea that has been advanced by some folks that the FAA may be liable in a court of law for failing to provide equal protection for air passengers under the age of two.

Mr. BRODERICK. Mr. Lightfoot, I can only tell you that there are literally four or five or six decades of history that surround the rule that allows infants to be held on laps. I don't know why that decision was made when the rule was written in the 1930s or 1940s, and I am confident that we won't find a good rationale in the archives for it. We did not do the kind of analysis back then that we do today.

With regard to your second question, I can't give you a competent answer to that. I'd have to ask some kind of attorney or Constitutional lawyer or something.

Mr. LIGHTFOOT. Well, I appreciate that.

Several decades of rationale as to why youngsters aren't restrained—wouldn't we also have that same several decades of rationale as to why adults and coffee pots and corpses and everything else are restrained? Could we make an argument here that maybe this has been an unintentional oversight over the years, that for some reason these children were left out, and forget all this bogeyman stuff about assumptions of who is going to drive cars because airline tickets may go up?

Mr. BRODERICK. Mr. Lightfoot, you certainly could do that, but I wouldn't be fulfilling what I think is my responsibility as a public servant to ignore the consequences of a regulatory action that I was proposing.

We are required, morally and by numerous regulations, to analyze the effects of our regulatory action. You do an analysis like that which we have done, and you find out that not only your analysis but four different studies done by four independent people tell you that you will cost more lives by this apparent safety improvement than you will gain. We can't in good conscience suggest that the FAA go forward with that. It just is not an improvement in safety. It's a net loss.

Mr. LIGHTFOOT. I had asked you earlier about that, and you said you would submit the cost on the study. I also would like to know if you competitively bid for it, as well.

I guess I'm left with a feeling of frustration that is common to those of us in the midwest who once again feel like common sense and logic has been dashed down by bureaucratese and doubletalk and so on. I would only say that if your assumptions are correct, and my baby is that one baby that dies, I don't give a damn about your assumptions.

Thank you, Mr. Broderick.

Mr. **Oberstar**. Mr. Broderick, I would like for you to submit for the record a report on the status of FAA efforts in cooperation with the British Civil Aviation Authority to develop a common international standard for child restraint seats.

Mr. **Broderick**. We'd be happy to do that, sir.

Mr. **Oberstar**. Thank you.

[Information received from Mr. Broderick follows:]

On March 20, 1990, the Air Transport Association (ATA) informed the FAA that the British Civil Aviation Authority (CAA) had notified British air carriers that children below the age of two could use either approved car seats or supplementary loop belts. The CAA notice to British air carriers indicated that only those child restraints approved by the CAA or the National Highway Traffic Safety Administration/FAA were acceptable.

The ATA petitioned the FAA on June 14, 1990, to allow its members to use car seats approved for use in aircraft by civil aviation authorities of other nations. That petition has been docketed (No. 26276). However, because the petition failed to meet certain requirements of 14 CFR 11.25, the FAA requested, by letter dated July 30, 1990, the following information from ATA:

1. The text or substance of the proposed rule change.
2. A summary, suitable for Federal Register publication, which includes a brief description of the rule change and the pertinent reasons for instituting rulemaking procedures.

As of September 13, we have not received a response from ATA.

In addition to the rulemaking actrivity, the FAA is participating with ATA, CAA, and Transport Canada in an ATA sponsored activity of the Society of Automotive Engineers (SAE) Ad Hoc Committee on Child Restraints. The SAE committee's activities have been directed at assuring the continued availability of child restraints that can be used in motor vehicles and aircraft. One of the major issues which the SAE committee will review is the possible use of child restraint systems from other countries by U.S. air carriers.

Mr. **Oberstar**. We hold you excused, and thank you very much for your testimony. I think you've heard some very heartfelt statements from my colleagues on the committee.

Mr. **Broderick**. Thank you, Mr. Chairman.

[Mr. Broderick's prepared statement appears on page 125.]

Mr. **Oberstar**. We have a vote in progress on the House floor. We will recess for that vote. When we come back we will take the next panel, consisting of Ms. Michaelson, Ms. Bianchi-Sand, Ms. Brown, Mr. Coleman, and Mr. Witkowski.

[Recess.]

Mr. **Oberstar**. The subcommittee will resume its sitting. We invite to the table the next panel, which has already been called by name.

We have Ms. Michaelson, Ms. Bianchi-Sand, Ms. Brown, Mr. Coleman, and Mr. Witkowski.

Thank you very much for being with us.

Ms. Michaelson, a very special thank you to you. I know how painful it must be to relive the nightmare that you experienced, but I ask you on behalf of the subcommittee to do so only in the sure knowledge that you are making a grander contribution to safety for others who will never know you personally, but may know that your intervention helped improve safety and perhaps save others' lives.

Please proceed.

TESTIMONY OF LORI MICHAELSON, PASSENGER ON UNITED AIR LINES FLIGHT 232, SIOUX CITY, IA; JAN BROWN, FLIGHT ATTENDANT, UNITED AIR LINES FLIGHT 232; SUSAN BIANCHI-SAND, PRESIDENT, ASSOCIATION OF FLIGHT ATTENDANTS, ACCOMPANIED BY MATTHEW FINUCANE, AIR SAFETY AND HEALTH DIRECTOR, ASSOCIATION OF FLIGHT ATTENDANTS; WALTER S. COLEMAN, VICE PRESIDENT, OPERATIONS, AIR TRANSPORT ASSOCIATION; AND CHRISTOPHER J. WITKOWSKI, EXECUTIVE DIRECTOR, AVIATION CONSUMER AND ACTION PROJECT/PUBLIC CITIZEN

Ms. MICHAELSON. Mr. Chairman and members of the committee, thank you for having me and giving me the honor of appearing before you and being able to testify on an issue that has been of the utmost importance to our family this past year.

My name is Lori Michaelson. My husband Mark, our sons Doug, six, and Andy, four, and our daughter Sabrina, eleven months, and I were among the 184 survivors of UAL Flight 232 that crashed in Sioux City, Iowa on July 19, 1989, in which 112 people lost their lives. We were in the process of moving from Denver to Ohio.

Prior to this flight, I did not give much thought to the policy of having a baby in my lap during a flight. Now I feel the risks of injury or death posed by the practice of allowing "lap babies" is real. It also justifies the need to mandate child restraints for children under three years of age traveling on airliners.

At present, until this is mandated, parents bringing their children into the aircraft unrestrained need to be able to make an informed decision about the danger they impose on their children when they have a "lap baby." The time for keeping this reality hushed is over.

The National Transportation Safety Board has been quoted as saying that 80 percent of large commercial aircraft crashes that manage to land are survivable. The logic I have heard some of the public use for not buying a seat for their infant is that they all will probably die if the plane crashes. This belief is not true. Therefore, in light of this fact shouldn't our infants have as much of a chance at survival as the adults and older children?

The crash of Flight 232 amazed everyone with the number of survivors. I feel the need to cite some specific situations that happened on 232 in relation to the four passengers listed as infants on board. By doing this, you can better appreciate the importance of the legislation we look at today. The following scenarios demonstrate without question why this bill must be passed.

Imagine watching your 23-month-old float to the ceiling, and then travel at a high rate of speed towards the rear of the plane. This is what the mother has to relive as a last memory of her little boy who was killed on UAL 232.

Or imagine being the parents of another 23-month-old who was sitting on the floor between each of them, each holding onto one of this little boy's arms on each side of him, fighting the forces of a crash landing at 200 miles per hour that threatened to rip his arms from his body or, more likely, throw him from their grasp. Imagine another 23-month-old at the point of impact being grabbed in mid-air by his young mother, but not before sustaining bumps to his head and body from hitting the sides and ceiling of the plane.

And, in our case, having our 11-month-old baby screaming, while being held on the floor, after being awakened from a nap, as a crash landing was to definitely take place. Picture me, a person only five feet, three inches tall, trying to bend over to reach the floor to hold onto my baby, a task that was almost physically impossible. Then picture the vulnerability that I felt, having one hand on my daughter, and holding blankets and pillows over her head with the other. This crash position was a change from what I was initially told, which was to hold her in my lap. There has never been such a feeling of helplessness and terror in my life.

And imagine being so consumed by our baby's vulnerability and sure fate that our 4- and 6-year-old sons were not able to get the support from their mother—or even the last parting words—that they deserved.

Isn't it curious that "lap babies" are also called "missiles" in airline lingo? How descriptive of their possible destiny.

The crew did a magnificent job in the handling of this emergency situation, but we do fault the FAA for not making more clear-cut policy for emergency situations. Would you feel secure with the current measures to protect your baby? We had to get the attention of a flight attendant from the aisle and ask her how to best protect our baby. I can still remember the look in her eyes, as we both knew this baby had a slim chance at surviving the crash landing. To know in your gut that all these measures surely would not have any chance of affecting the ultimate outcome is overwhelming.

Then know the sickening feeling of realizing our baby was being sucked out of my grasp as the plane flips over, and the mental imagery of her fate and the knowledge of knowing I had to get two other children away from the plane to safety. Go through the mental imagery of her fate and the knowledge of knowing I had to get two other children away from the plane to safety.

Imagine her father, my husband, hearing the cry of his infant daughter once, and not being able to find her amid smoke and flames, being finally forced to abandon his efforts——

Mr. OBERSTAR. Take your time. It's a very painful experience to recount.

Ms. MICHAELSON [continuing]. Knowing that she still may be alive. He could have easily lost his life searching for the baby.

I wonder how many others of this and other crashes have lost their lives, going back into the wreckage to search for the cries of other lost children?

It is only due to thanks to God that our daughter survived, and not to safety measures used in our emergency situation.

Our daughter, Sabrina, was found by another passenger, Jerry Schemmel, who had already gotten outside of the wreckage, and went back in after hearing her cries. Luckily she was conscious and able to cry out, allowing Jerry to hone in on her location. She ultimately ended up in an overhead storage bin, which was now on the floor, approximately 15 rows to the rear from where our original seats had been.

Since this crash I have been working with the media, both locally and nationally, on the issue of making infant restraints mandatory on airliners. I feel it's the one positive thing that I can have a part in from this terrible ordeal. Also, everyone involved hopes for improved and safer plane design. I encourage the members to read the Airline Pilots Association's "Analysis and Recommendations Regarding Flight 232." Please heed their suggestions. They are the ones in the skies when disaster strikes, not the FAA officials.

I am making a plea to the members to vote to make it standard policy, that all children be restrained during a flight, not just the adults and older children. In a quote from Nora Marshall of the NTSB from USA Today on 5/23/90, she states, "Everything in the cabin, from a coffee pot to your carry-on luggage, has to be restrained, except children under two." How much sense does this make?

In February of this year, the Air Transport Association publicly stated child restraint systems were the safest way for babies to travel. Why is it that I still hear of the hassles that the parents are getting at the gates, even when they have purchased a seat?

At present, it is not fair to put the burden of making children safe in the skies on their parents. It is up to the FAA to make sure that air travelers are as safe as they can be, all of them. This is especially true when an emergency landing, or the more frequent occurrence of turbulence, is present.

The FAA argues that a Harvard Medical School study suggests only three children would be saved in a 10-year period if safety seats were required. Is the overall conclusion at FAA, of three children being killed, taken to be "an acceptable level of risk"?

At present, assuring passenger safety in regard to children under two means it is up to fate and luck if the plane encounters turbulence, or crashes, as Flight 232 did.

I am also a Registered Nurse. Would it be acceptable for Congress for a doctor or a nurse to consider a patient as an "expendable package" before the patient reaches the age of two?

From the economic standpoint, the FAA has argued that parents should not be required to buy a seat for their infants because the expense might cause them to drive instead of flying. Do they know this for certain? It assumes the airlines have no imagination, no vision, and no empty seats on any flights. In fact, airlines could schedule flights with free seats or half price seats for children, just as they do for senior citizens. I am sure the marketing departments would create competition between airlines that would probably result in the customer being the beneficiary in cost and safety. Who wouldn't want to be know as the safest airline for kids, and not just the "official airline for kids," as one TV advertisement states?

It is time for Congress to tell the FAA that America has the same standard for voting and flying—one man, one vote; and one passenger, one seat on the airplane.

Children don't vote, but their parents do. No parent wants to pay more for a seat on a plane than they have to. On the other hand, no parent wants to experience what we did on Flight 232 when the plane crashed.

Thank you for your time and hearing my views on this issue. God bless and may you all have uneventful flights.

Mr. OBERSTAR. Thank you very, very much for delivering what I know as a very difficult statement to make, a very difficult and painful moment to relive.

For me, it recalls perhaps—it rivals only the testimony given some years ago by Flight Attendant Joan Jackson, who survived civil aviation's worst crash at Tenerife, Canary Islands, when she told the Subcommittee on Investigations and Oversight dramatically how she led 60 passengers to safety through the over-wing exits, which the FAA was being petitioned by several air carriers to close off. That was very powerful testimony that turned around an FAA decision.

Thank you.

Ms. Bianchi-Sand.

Ms. BIANCHI-SAND. Mr. Chairman, if it is acceptable to you, I would ask Flight Attendant Jan Brown to speak before I do.

Mr. OBERSTAR. Please.

Ms. Brown, please proceed.

Ms. BROWN. Good afternoon, Mr. Chairman and members of the subcommittee. My name is Jan Brown. I have been a flight attendant with United Airlines and a member of the Association of Flight Attendants, AFL–CIO, for 13 years.

Last year on July 19th, I was working United Airlines Flight 232 from Denver to Chicago when the hydraulic system failed and we made an emergency landing in Sioux City, Iowa. For 40 terrifying minutes I and the other flight attendants on board prepared the cabin and passengers, including the infants sitting on their parents' laps, for the emergency landing and evacuation. It is an honor to be here today to briefly tell you about my experience on Flight 232 and to discuss the life-saving importance of requiring child restraint seats on airplanes for children under two years old.

As a flight attendant, my primary responsibility is safety. I am responsible for carrying out many of the Federal Aviation Administration's regulations which protect the flying public. For example, before the airplane door can be closed and the plane can move, I must ensure that all carry-on baggage is properly stored and secured. The FAA requires that I make sure all galley supplies are secured for takeoff and during landing. I must also check to see that all passengers two years old or older are wearing a seat belt for takeoff, landing, while seated during flight, or when the captain deems it necessary. In addition, flight attendants are required to be harnessed in their jumpseats for taxi, takeoff and landing.

The FAA requires these precautions to assure safe travel for passengers and crew. Yet, if we must make sure that food and beverage items are secure and baggage is properly stored, why do we allow children under two to sit unsecured on the laps of adult passengers? Even an onboard pet is safer in the protective confines of a required pet carrier.

Throughout my career I have seen many parents with infants sitting unrestrained or loosely held on their laps. I have seen infants unrestrained in empty seats and children allowed to stand or toddle up and down the aisle during flight. Recently, I saw a three-year-old child sitting on her mother's lap, traveling as a "lap child." Three-year-olds are required to have their own seats.

I have always been concerned that these unprotected children would be injured during unexpected turbulence and have studied the issue. I have learned that tests conducted at the FAA lab in Oklahoma City proved that in moderate to severe turbulence, a child's weight can multiply up to five times its normal weight. The tests' results indicate that it would be nearly impossible for an adult to hold a child against such G forces, and these G forces are generally less than what would result in a crash.

In addition to these facts, all 50 states require child restraints for infants in cars. Cars generally travel at speeds up to 65 miles per hour. Airplanes travel at 500 miles an hour. While it is true that there have been few documented deaths of infants traveling on airplanes in their parents' laps, aren't "a few" deaths enough? This data does not include those children who are injured due to heavy turbulence each year. No statistics are recorded for infant injuries.

As I said earlier, over the past 13 years I have often worried about the infants on my flights who are not properly restrained. Yet, nothing could have prepared me for last July 19th. On that beautiful sunny day, I was enjoying a smooth flight and everything was under control. A momentary explosion turned serenity into disaster. After being informed by the captain that we would need to make an emergency landing, my flight attendant colleagues and I began preparing the cabin. We secured all baggage and food and beverage carts. As we approached Sioux City, we assisted passengers with infants on their laps. We instructed them to wrap their children in blankets and pillows, place them on the floor, assume a brace position over them, and then hold the babies with all their might.

Once the passenger preparation was completed, I harnessed myself in my jumpseat and waited for the brace signal. I mentally reviewed all that had been done. While thinking of the infants we had on board, I recalled an incident a month earlier when, in heavy turbulence, two infants were torn from their parents' arms and thrown through the air. One of the infants was sent to the hospital for its injuries.

Within minutes we impacted, an impact that no words will ever adequately describe. Our world simply exploded in those few moments, and unconsciousness was my life-saving blessing. When the plane stopped moving, I regained consciousness and evacuated passengers through a break in my section of the plane. I then exited as deadly smoke approached my position. Making my way through the cornfield, the first passenger I met was Sylvia Tsao, who was headed back towards the burning section. She told me she had to return to the plane to find her infant son. I restrained her from proceeding and told her someone would find her son. She turned to me and blurted out that I had told her to place her son on the floor and hold him. She had done that and now he was missing. I was overcome with the knowledge that I would live with those words for the rest of my life. Evan Tsao died in the crash.

I then saw Lori Michaelson in the cornfield. She was carrying her infant daughter Sabrina. When I asked her if she had been able to hold her daughter to the floor upon impact, she answered that she had not been able to hold her. Sabrina survived.

The flight attendants on Flight 232 followed the prescribed procedures for protecting infants in emergency situations. We did the best we could, frustrated by the limitations, and watched a parent grieve at the loss of her son and heard the miraculous story of Sabrina's recovery.

I will never forget that day in July. Each time I see parents holding their children on their laps in airplanes, I shudder.

I believe that the only mistakes we make in life are the ones from which we learn nothing. We must learn from these mistakes. No parent or flight attendant should again be placed in this same situation. It is a tragic mistake to allow infants to travel by air unrestrained. Some say it will cost parents too much to pay for their infants to travel. If cost is the major concern, I think we are placing a price tag on a small child's head and engaging in a game of Russian Roulette.

The airlines have the responsibility of transporting passengers safely. The FAA has the responsibility to mandate safety issues. Parents are responsible for their children and flight attendants are responsible for the safety of all passengers. No cost is too high if it means protecting infants from injury and possible death. We must require the use of child restraint seats for all infants. We must not wait for another statistic. The next one could be your own child.

Thank you again for this opportunity to appear before you today and talk about the need for child restraint seats. I urge your support of Representative Lightfoot's bill, H.R. 4025, and I urge the FAA to issue rules.

I would be glad to answer any questions you may have.

Mr. OBERSTAR. Thank you very much for a very, very moving statement. Even though we have a vote in progress on the House floor, perhaps we could continue with Ms. Bianchi-Sand's testimony until after the second call.

Ms. BIANCHI-SAND. Thank you, Mr. Chairman. I have condensed my remarks.

Mr. OBERSTAR. Your statement will appear in full in the record. You may summarize.

Ms. BIANCHI-SAND. Thank you.

With me today is our Director of Air Safety and Health, Matthew Finucane. Time permitting, I'd like to ask Mr. Finucane to make a comment with regard to some testimony earlier today by Mr. Broderick of the FAA.

As this committee knows, flight attendants are safety professionals. Our most important job on the aircraft is to ensure that passengers are properly restrained prior to a crash, and to assist them in immediate evacuation before the plane is consumed by fire.

We simply cannot do this job when it comes to an unrestrained infant. If the child is placed on a parent's lap, the child may break free from the adult's arms as the plane decelerates and strikes objects on the ground. If the child is placed and held on the floor in front of the bulkhead, the child may also fly about the cabin during the jolting surface movements of the aircraft.

A child that breaks free during a crash faces two serious hazards. First, the child may be injured as she or he strikes the aircraft interior during the crash. Second, the parents may not be able to find the child after the crash, and the child can die during the fire.

As Lori Michaelson and Jan Brown have already testified, this is precisely what happened at Sioux City.

Another serious problem facing unrestrained infants is turbulence. In 1974 we had an incident where an infant was strangled due to severe turbulence when its neck was caught in the seat belt after it fell out of the seat during the turbulence. At one of our carriers last summer, an infant flew out of its mother's arms during turbulence and the mother couldn't find it until she heard it crying from underneath the garment bags, which had also fallen out of the closet due to the heavy turbulence.

In January of this year, as the NTSB has already testified, we had a seven-week-old infant that suffered serious head injuries on a DC-10 during turbulence. This was the only passenger that suffered injuries during that incident.

Just a week ago two parents, on a flight on one of our carriers, became so nauseated that they needed to use the air sickness bags. They handed their child to the flight attendant. The turbulence was so severe that the flight attendant had to sit down and restrain herself in her seat. She lost the baby. The baby flew into the air and was out of her sight. A man seated behind the flight attendant picked up the baby.

Members of the subcommittee, there is absolutely nothing in the FAA Act that allows the administration of the FAA to provide one level of safety for adults and another level of safety for children. One has to wonder why the FAA is fighting mandatory infant child restraints, when there is so much support for it among the industry, consumer groups, the NTSB, and crew member groups. We believe that the FAA's position relates to the low priority that it gives to crash survivability in general.

We do not have to remind this committee that the FAA has dragged its feet in at least a dozen cabin safety areas, from life vests to dynamically-tested seats for adults, to reduced exposure to toxic fumes in post-crash fires.

Even though we question the FAA's motives for opposing this safety improvement, it is important to evaluate their arguments.

As might be expected, the agency argues that placing infants in restraints is problematic because of the cost. Yet, as has been spoken to here earlier today, all safety improvements cost money. Redundant hydraulic systems are not free. Machines that would detect plastic explosives in baggage are not free. Dynamically-tested seats that would protect adult passengers are not free, yet all of these safety improvements are needed. We categorically reject using cost as a reason for ignoring a known safety hazard and for not implementing the improvement when it is known.

The FAA has also argued in press statements that the cost to parents of mandatory child restraints may cause them to switch to automotive travel, which is less safe, in their opinion. We have several questions about this argument.

First, will carriers charge such high fares for infant seats that parents will turn to automotive travel, thereby causing the carriers to lose revenue? If that's so, why today do some carriers allow properly restrained children under two to fly for free if there is an empty seat on the airplane?

Second, assuming that the airlines will exploit mandatory child restraints to increase revenues, and assuming that some parents will turn to automobile travel, how much of a safety impact will this change in travel have? After all, we may be talking about a very small percentage increase in total vehicle miles traveled, perhaps nine thousandths of one percent. Moreover, these substitute vehicle miles will probably be driven by a head of household traveling between major cities with an infant on board, as opposed to a teenager or a drunk driver on a weekend evening. Is the FAA predicting that the number of small children killed in vehicles each year, about 382 under two years old, will go up as the result of the possibility of a fraction of a percent increase in automotive travel?

Finally, if the Government really wants, as a matter of safety policy, to promote air travel over car travel, why not put a halt to all proposed air safety improvements, since the increased cost of these improvements might show up in ticket prices and force some individuals to drive instead of fly? Or perhaps we should increase air safety but place a ceiling on all air fares, while creating disincentives for automobile travel, such as increased automobile gasoline taxes. We are not necessarily opposed to moving travelers from cars to planes for safety reasons, but we are curious why the FAA's interest in doing so begins and ends with children under two.

If the FAA can convince the subcommittee that it has a legitimate automobile safety argument, we would urge Congress to consider how it might strongly encourage—or even require—the airlines to place a reasonable ceiling on fares for those using child seats. One step we would like to see would be for the airlines to issue some bold pronouncements on their own concerning low or free fares for children in restraint devices. Surely some airline would like to be known as the "family" airline.

Our job as flight attendants is to make sure that passengers arrive safely at their destination. We are here today to ask the subcommittee to give us the tools to do that, including a safe seat for every passenger.

I thank you for the opportunity to testify. And this is a moment where I would like to ask Mr. Finucane to make a brief comment on the record.

Mr. OBERSTAR. Thank you very much. We will take a comment from Mr. Finucane when we return from the vote presently in progress. We'll have to take a very short recess.

[Recess.]

Mr. OBERSTAR. The subcommittee will please come to order and resume its sitting.

We will next hear from Mr. Coleman, Vice President for Operations, Air Transport Association.

Mr. COLEMAN. I believe Mr. Finucane wanted to speak.

Mr. OBERSTAR. Oh, I'm sorry. Yes, at the moment that we broke, Mr. Finucane was to make a statement.

Please proceed.

Mr. FINUCANE. I really had just one comment. I wanted to comment on Tony Broderick's assertion earlier that there are four independent studies which have independently reached the same conclusion as the FAA.

I would just like to mention that one study is the FAA contractor report, which estimates a little under one fatality per year. Another study, by McKenzie and Lee, relied upon the FAA's estimate as to the number of passengers who would be dissuaded from flying by a mandatory child restraint rule. A third study, by McKenzie and Warner, was written in 1987 and has no mention of infant child restraints in it. The fourth study is by the University of Maryland professors who are testifying today.

So I think that in at least some of those studies, you have to question whether they have independently reached the same conclusion as the FAA.

Mr. OBERSTAR. Thank you. That's very helpful commentary. Mr. Coleman.

Mr. COLEMAN. Thank you, Mr. Chairman.

Good afternoon. I am Walter S. Coleman, vice president, Operations, of the Air Transport Association of America. ATA represents 20 U.S. airlines, 17 of which carry passengers. The ATA appreciates the opportunity to appear today to discuss the important issue of child safety restraints. The ATA would also like to recognize and commend the leadership of Congressman Lightfoot and his colleagues who have cosponsored legislation on this important issue. We support H.R. 4025.

Mr. Chairman, I will summarize my remarks and ask that my full remarks be included for the record.

All aspects of airline flight operations are under constant examination, with an objective of improving safety. The majority of this scrutiny comes from the individual airlines, who review their own and the industry's efforts and successes in achieving the highest level of safety. The ATA member airlines' decision to seek a change in the regulation to prohibit infants under the age of two years old to travel without being restrained is an example of our quest for increased safety for the air traveling public.

The Air Transport Association, on behalf of its member airlines, filed a petition on February 22, 1990 which, if it were to become a rule, would require that all passengers be restrained during takeoff, landing, and when directed by the Captain. The single purpose of this petition is to remove the language in the Federal Aviation Regulations which requires a restraint for passengers who have reached their second birthday,and which effectively results in many children under the age of two traveling in the arms of an adult. The arms of an adult are not a satisfactory safety restraint in an airline cabin.

There is little doubt that the Sioux City DC-10 accident in the summer of 1989 provided the stimulus for the airline industry to consider, and then file, our petition. The Sioux City accident was unique in that the cockpit and cabin crew had time to prepare for an anticipated emergency. They expected an abnormal landing which could result in injuries, and even a loss of life. In compliance with FAA regulations, the flight attendants prepared the cabin for the emergency landing by storing or restraining all loose items in the cabin. Everything in the cabin was restrained except for the four infants traveling in the arms of adults. The ATA petition, if it were to become a regulation, would not permit this circumstance to occur again.

There are some who believe it has taken too long to decide that infants should be restrained when traveling on an airliner. Perhaps it has taken too long. However, it was not so long ago that automobile occupants were not required to wear seat belts. Similarly, it has only been since 1985 that all 50 States required that small children traveling in automobiles travel in car safety seats.

As we noted earlier, all loose items in an airline cabin are stowed prior to takeoff and landing. Infants held in the arms of their accompanying adult are the sole exception. The permissive language, which does not require infants under the age of two to be restrained, can be found in the regulations of 40 years ago. The 1953 Civil Air Regulation, Part 40.174, states that "A seat and an individual safety belt are required for each passenger and crew member, excluding infants." This regulatory requirement is not particularly surprising. Seat belts on airplanes have not changed significantly in the last 40 years. A small infant who cannot support his or her head in an upright position and whose body structure has not matured enough to be protected effectively by a passenger safety belt should not be strapped into a passenger seat with a standard adult safety belt.

However, child safety restraints that were not available 40 years ago are available now, and they have been approved by the regulatory authorities. We think that if child safety seats such as we now have would have been available at the beginning of commercial aviation, they would have been identified as the appropriate protection for infants traveling by air, and would be a familiar and accepted part of air travel. Now that these seats are available, we should provide the maximum protection for infants when they travel by making the use of some sort of child safety restraint mandatory.

A fundamental part of the discussion of requiring the mandatory use of child safety restraints is the issue of cost. Since an infant who is not yet two years old presently travels at no cost, will a charge for a seat to be occupied by an infant cause the accompanying adult or adults to choose not to travel by air? If that is true, what is the net safety outcome if the family unit elects to travel by automobile? Auto travel is less safe than air travel. There are few infant fatalities in air travel because there are few fatal air carrier accidents, and if many travelers chose not to fly and went by automobile instead, the result could be a net increase in infant—and adult—fatalities. However, we believe that these potential airline passengers are still gong to choose to fly. We believe they will continue to choose to fly because the airlines, rather than risk the loss of one or more adult fares or perhaps an entire family unit, will offer a fare arrangement acceptable even for families traveling with infants who previously would have flown free.

Mr. Chairman, the airlines have a responsibility to transport their passengers safely. We want people to fly. We fully anticipate that the marketplace will create a competitive climate that will continue to attract adults traveling with infants. It is not in our interest to discourage potential customers from flying.

While certainly no one likes to contemplate the prospect of air travel emergencies, it is the airlines' responsibility to do so. Recently several important safety improvements on airliners have been introduced to increase survivability in the event of an emergency: Fire blocking seats; fire resistant interior cabin materials; lavatory smoke detectors, and the 16 G seat are some of them. Child safety restraints should be added to that list.

That completes my statement and I would be pleased to answer any questions.

Mr. Oberstar. Thank you very much.

Now, Mr. Witkowski.

Mr. Witkowski. Thank you, Mr. Chairman and members of the subcommittee.

On behalf of the Aviation Consumer Action Project, I appreciate this invitation to testify about the need for child safety restraints aboard airliners. ACAP was founded in 1971 and is the only nonprofit consumer organization working full time on aviation matters.

ACAP strongly supports the proposal to require that infants and small children be restrained in approved child seats during airliner takeoffs, landings, and in-flight turbulence. Clearly, the Nation's youngest and most vulnerable airline passengers deserve the same protection that has long been required for adult passengers. Under current law, children under the age of two are the only passengers that need not be restrained during takeoffs, landings, and turbulence. Even carry-on baggage must be securely stowed at these times. And, as the National Transportation Safety Board pointed out, they called it a major contradiction in FAA regulations that youngsters are unrestrained, and all of the so-called "items of mass" must be secured. And they warned of the risk that this poses, both to infants and to other passengers on the plane, which may be an argument that the FAA could use to the airlines to spread the cost throughout all of their ticketholders on the flight, not just the parents of the infants on the plane.

As a consumer group that works for competitive and reasonable fares as well as aviation safety, ACAP is keenly aware of the cost considerations related to a child restraint requirement. Some parents may worry that they won't be able to afford a ticket to fly if they must purchase an additional ticket for their infant. ACAP, however, believes it is possible to provide this important new safety protection without imposing a prohibitive economic burden on parents with young children.

Currently, U.S. carriers do not require parents to purchase tickets for their lap-held babies. In addition, the airlines allow parents to set up child restraint seats at no charge if there are vacant seats available. This is often the case, since the vast majority of airline flights are not fully loaded. According to some industry experts I've talked to, they estimate that no more than 5 percent to 6 percent of airline flights are fully loaded. So this means that probably well over 90 percent of flights do have vacant seats available, and it's possible that the airlines could work out some kind of a system to possibly reimburse parents, even, who have bought a ticket and end up flying on a flight that has vacant seats available.

Ideally, the airlines would make similar provisions—such as allowing children to fly for free, or on a discount—even if child restraints were mandatory.

The FAA estimates that four million children under the age of two fly with U.S. carriers each year, each of them accompanied on the average by two adults and one other child between the ages of three and five. Ever since airline deregulation, U.S. carriers have offered an ever-changing menu of fares designed to attract and hold the loyalty of their passengers. It is unlikely that the airlines will sacrifice large numbers of family customers, who pay substantial fares already, by charging prohibitive fares for the infants who now fly for free.

Briefly, I want to address two reports that were submitted to the FAA. One is by the Competitive Enterprise Institute that predicts that child restraint requirements would force many families back on the Nation's highways. This report, by Richard McKenzie and Dwight Lee, relies on an FAA estimate that airlines will charge half fare for all infants and experience an 18 percent drop in infant boardings. We find it doubtful that airlines would set fares so high as to drive away the adults attached to nearly one-fifth of all infant boardings.

The paper also uses national statistics on highway accidents, injuries, and deaths which include high-risk groups, such as unmarried young men and intoxicated drivers. This fails to recognize that accident statistics are likely to be considerably lower for parents traveling with young children.

The other issue related to mandatory child restraints is the question of who would provide the safety seat. Many parents now own child restraints that are approved for use in aircraft as well as autos. These parents should be allowed to use their own restraint seats during flight. Other parents who come to the airport by limo, taxi, public transportation, or from foreign countries without an infant seat requirement probably would need for the airline to provide them with a seat. Airlines could provide seats at nominal or low cost. Auto rental companies do it for about $3 per day

ACAP believes there is no reason not to require that infants be properly restrained on board airliners, just as they are in automobiles. ACAP has received many letters from consumers advocating mandatory child seats. As one woman so eloquently wrote to ACAP, "This is a country of choice. As adults, we choose ways to keep ourselves safe, but until our children can decide for themselves, it is up to us to keep them safe."

I urge the subcommittee to approve legislation that will help make mandatory child restraints a reality on U.S. carriers.

One point I would like to make is this. I have been involved in hearings on aviation safety before, and it sometimes helps to look at the history of this particular issue.

In 1981, Mr. Stuart Miller filed a petition with the Federal Aviation Administration calling for a mandatory rule on infant seats. At that time the FAA said that they did use a cost-benefit analysis, and said that it would cost parents $56 million for a mandatory seat rule, according to their estimates, in order to save the life of one child per year, which at that time they valued as $500,000, and they denied it on that basis.

Basically, we filed a petition to FAA a year after that, calling for a rule that would require the airlines to purchase child restraints and allow the parents to use that restraint at no charge, as long as they made a reservation at least 24 hours in advance and there was a seat available. The FAA has sat on that petition for six years, has not addressed this question of the unsafe travel of young children. It wasn't until the Sioux City crash last summer that this issue came up again.

One of the spokesmen at the FAA was quoted in the Washington Post as saying that the reason that children were not restrained on that flight is that "the law says we can't require anything that can't be justified for safety reasons, and there haven't been that many infants killed on airlines to justify changing it." That was FAA spokesman Fred Farrar.

Now, because that didn't play well in Peoria nor in Sioux City, the FAA is backed into a corner, and now they're using a study that says, "Well, we won't worry about the cost-benefit analysis. We'll just have a study done, and this study does show that there will be more people killed on the Nation's highways."

I'm sure that we're going to have an infancy rule sometime in the next five to ten years. Since the FAA missed the opportunity to pass on it back in 1981 and 1982, and we've seen infants killed since then because of that, I would urge Congress not to pass up this opportunity now to save the infants in the next five or ten years that otherwise could be lost, and not wait until the year 1995 or 2000, when I am sure there is going to be a mandatory infant seat rule.

Thank you.

Mr. OBERSTAR. Thank you very much, Mr. Witkowski, and my thanks to all the members of the panel for your very heartfelt testimony, very thoughtfully delivered.

Mr. Witkowski, on page 5 of your testimony you say that the study funded by FAA "fails to recognize that accident statistics are likely to be considerably lower for parents traveling with young children." You are in fact challenging the FAA-funded study. Do you have statistics, or does NHTSA have statistics, that show lower rates of highway accidents and fatalities for parents who are driving with young children than for the general population?

Mr. WITKOWSKI. The study that I was thinking of that had been done on this issue was just published—Risk Analysis is the name of the journal, and it was published by researchers at General Motors. What they had done in that study was look at specific groups of drivers, and in the case that I'm thinking of they said that 40-year-old prudent drivers, properly restrained and driving on interstate rural highways, were at less risk on a per mile basis than airline passengers in trips of 600 miles, and were half as safe in trips of 300 miles. So in longer trips than 600 miles they would be less safe than airline passengers.

But that was an example of one study that showed that, focusing in on a specific group of safer drivers—which probably parents driving with young children in an automobile would reflect, as opposed to using an average which also includes intoxicated drivers and young male drivers—would be a better thing to focus in on the so-called "safety loss" if there is a diversion of traffic from the airplanes to the cars.

Mr. **Oberstar.** In the mix of the statistics that we're dealing with here, the FAA has chosen—or has been directed—to conduct this cost-benefit analysis. If the analysis that has been conducted omits an important factor or just considers that parents who are drivers accompanied by young children have different accident statistics than the general population, then to that extent the FAA study is defective.

Their whole opposition to imposing a rule rests on the argument that the high cost of traveling with infants aboard aircraft will force parents to a less safe mode of transportation, and they have the studies that they rest their case upon. If their studies are defective to the extent that you've suggested, then FAA needs to go back and review that matter and revise their thinking.

Mr. **Witkowski.** I agree, Mr. Chairman. One point of clarification that I want to make, the study to which I was referring when I made that statement was the study quoted by the Competitive Enterprise Institute. I'm not certain that the Apogee study doesn't focus in on the group of parent drivers as a specific group, because the FAA in their wisdom has not allowed any of us to look at that study until after this hearing is over. That's one of the first things I'm going to do, is look into that study and determine whether or not they used an average risk pool, or did focus in on diverted families from airliners, who would tend to be safer drivers, and whether that was considered.

Mr. **Oberstar.** Yes.

Mr **Witkowski.** It's an important consideration. It's one of the policies being foisted upon young children that possibly could be based on a faulty assumption.

Mr. **Oberstar.** Mr. Coleman, are your constituent members, the respective air carriers, willing to put their—as the term is so frequently used in financial analysis—their bottom lines on the line for safety by encouraging child safety with the lure of a discounted fare for passengers who bring with them an infant who must be held in the child restraint seat?

Mr. **Coleman.** With all the innovative marketing practices that our members do, I'm surprised that they haven't tumbled for that one, Mr. Chairman. They certainly have a history of offering incentive fares to try to get families to travel together, particularly if they can get families to plan their travel in advance and then execute it during a time when they have some empty seats.

We have not discussed that specifically with the carriers, as to whether they would find it attractive to offer an incentive if the passenger were going to use a child safety restraint. It's something to be discussed.

Mr. **Oberstar.** The argument that FAA has made on the cost side of the cost-benefit analysis here is that Traffic Alert and Collision Avoidance System and thrust reversers and hydraulic systems, which add costs because of the redundancy that is built in to assure safety on board aircraft, add costs to the construction of an aircraft, add costs to the maintenance of that aircraft, and are onetime costs, whereas the seat is a recurring cost for the passenger.

Every time you get on that plane you carry your infant, put that infant in a revenue seat, and that's a new cost for the passenger.

But if there were some sharing of cost--as you said, if the carriers with their high-speed computers can find ways to process several hundred thousand fares in a day, they surely can find inventive ways to offer incentives to the traveling public to travel safely, as well a cheaply.

Mr. COLEMAN. I think you're correct, and certainly, the yield management people who have that responsibility with the airlines would like to find ways to increase that yield.

Mr. OBERSTAR. Yes.

Mr. COLEMAN. I think that's likely.

I think we should point out that certainly, the parent traveling with a child that they elect to put in a restraint is in fact a beneficiary of that safety device more directly than any other passenger. The other people on the airplane are safer, too, as Mr. Witkowski pointed out, in that the child is restrained and everyone is better off, but it is the child and the adult who are the prime beneficiaries of that extra cost.

Mr. OBERSTAR. Now, the ATA has supported mandatory child restraint seats on aircraft, right?

Mr. COLEMAN. We petitioned, yes, sir.

Mr. OBERSTAR. Yes. But you would not want to have a mandatory fare—a ceiling or some sort of mandatory special fare—for families that use child restraint seats?

Mr. COLEMAN. Well, we think the marketplace is going to drive that.

Mr. OBERSTAR. You would prefer that the marketplace do that? So would I. And I would like to have you go back to your membership and then report back to this committee some thought process on that score, because I think there is a great deal of sentiment for doing something. The big obstacle here is the cost factor. If the carriers show imagination, I think the traveling public will respond.

Mr. COLEMAN. And the question you would like to ask of the carriers is, would they be interested in offering an incentive if you travel with a child safety restraint?

Mr. OBERSTAR. That's right.

Mr. COLEMAN. At a little risk of collusion there, we will sort that one out when we ask that question. [Laughter.]

Mr. OBERSTAR. Well, I hope that doesn't run afoul of antitrust. Certainly, the somnolent Justice Department that hasn't found any causes for bringing antitrust cases in other areas should overlook this one.

Mr. COLEMAN. Mr. Chairman, I'd like to point out that our petition sought to restrain children. I should point out that the petition didn't seek to put child restraints in passenger seats. It so happens that the only approved restraints are the ones that fit into passenger seats. As Mr. Geren spoke earlier, we'd be very pleased to find a child safety restraint that, in fact, did not use a passenger seat, but there isn't a lot of extra space in an airplane.

But we haven't ruled that out, and we continue to work very closely with FAA's Civil Aeromedical Institute to see if we can identify a good, approved safety restraint that would take away the economic burden.

Mr. Oberstar. I am sure that if we got Boeing and Douglas and the manufacturers of the smaller commuter and regional aircraft together and got the engineers for those carriers, who are so brilliant in designing the 757 and the 767 and 747-400 aircraft that can do all these other things, that they surely could find a way to design a safe seat restraint for a child. I just can't believe that it can't be done. After we reasoned with them about having a floor proximity lighting system, they found a way to put them on board aircraft when I told them, "If you can't figure it out yourself, go down to Disney World. They have them there."

Now, Ms. Michaelson, I'd like to ask you about that very question. It's a painful thing to ask, but nonetheless, you continue to travel with young children; we've all been through it, those of us who have families and young children. It's an additional cost. What about incentives from the carriers? What kind of incentive would you like to see as an inducement to use? Either use your own restraint, or have something aboard the aircraft, have them build seats—you know, those seats can be removed and put in very quickly. They can shuffle seats around an aircraft to change the configuration with very little difficulty.

Ms. Michaelson. Well, I've seen things submitted by inventors. There is a seat that is under testing now that can accordion right out of the normal adult passenger seat, so there's no excuse there for taking up that extra seat that an adult could use. You could use it either way. Unzip it out of the seat, and it accordions right out.

There have been a lot of inventors submitting things, and that's one of them. So there are solutions out there to be explored.

Mr. Oberstar. But I think that's simply a matter of technology, and I don't want to pursue that here. I do want to come back to the question of cost. As a parent who has a budget to live within, what kind of incentives would you like to see the carriers offer?

Ms. Michaelson. Some kind of discount for that young child. My husband travels a lot and uses frequent flyer mileage, so I can't put myself in that exact position because that's how we did a lot of our traveling. Part of our benefits of his high travel was using that mileage.

That's up to the airlines to come up with creative marketing. I can only hope that they come up with some form of discounting that isn't going to punish that parent that wants to bring the child.

Mr. Oberstar. We need not be scared off by that price tag that the FAA put on this matter.

Ms. Michaelson. No.

Mr. Oberstar. With some creative marketing on the part of the carriers, the cost factor surely can be overcome.

Ms. Michaelson. Yes. I don't think that's what holds it back. I think it's the public pressure in getting them to do it.

Mr. Oberstar. Thank you.

Mr. Lightfoot.

Mr. Lightfoot. We've got the second bell, so I'll try to make this quick.

First of all, Lori and Jan, both of you, we certainly appreciate your coming today and doing what I am sure is a very difficult job, but rest assured that it's well worth the effort and is going to contribute, I think, to a safer place to fly in the future. It troubles me somewhat, too, that Mr. Broderick is not here and staying for your testimony. I guess it's easier to sit in an air conditioned office and deal with assumptions than it is to deal with real people and real problems.

If I could, I'd like to go to Mr. Coleman first and follow up on what he and the Chairman were discussing.

From ATA's perspective is there enough research being done on infant seat alternatives, in your opinion?

Mr. COLEMAN. I guess if we had some new solutions, it would be easy to say yes. We don't have them yet. I must admit that we're getting very good cooperation from CAMI. I don't know if it's enough. It could be an appropriate target for some additional research and development money to ensure that CAMI could look into this kind of thing, and other parties, too.

As Ms. Michaelson said—and she's probably heard from some of the same people that we have—there are a lot of entrepreneurs and inventors out there who would like to solve this. We've made an arrangement with CAMI that whenever they send us anything, we send them a package and give them the address of CAMI and let those enterprising people introduce their ideas.

But I would like to see continued research. We are really not sure that we've gone as far as we could to identify a child safety restraint that didn't need a passenger seat.

So I guess the real answer to your question is no, because on the one hand we don't have a solution, and on the other hand we haven't determined that there won't be a solution.

Mr. LIGHTFOOT. Susan, you've done a lot of research and a lot of work on FAA's opposition in the past to different cabin safety improvements. Could you elaborate on some of that for us, when they have thrown up this so-called "cost-benefit" as the bogeyman, why we can't have safe air travel?

Mr. FINUCANE. Well, I think the FAA has opposed just about every cabin safety improvement that has come down the pike, such as dynamically-tested seats for adults, which took them almost 30 years of research to upgrade their 1952 standard for adult seats. Right now they are working on a proposed retrofit rule so that the improved seats will go into the existing aircraft. They have proposed a seven-year retrofit based on a cost-benefit analysis.

If I could, let me just mention how that cost-benefit analysis worked. They have better seats now for adults, and they have chosen seven years as the time period to install them because that's the normal attrition cycle for adult seats. Therefore, no airline will have to buy a seat that it wasn't already planning to buy. So you can see that there is a pervasive problem where they use that analysis.

Chairman Oberstar and Congressman Mineta fought for many years for floor-level lighting, protective breathing equipment, and passenger smoke detectors. The FAA's resistance was so bad that Congressman Mineta had to get a monthly report from the FAA on whether they were making any progress in these kinds of safety areas. So there's historical opposition in the FAA to crashworthiness. For a long time the FAA wouldn't even allow the NHTSA-approved car seat to come onto the aircraft. They said, "This

NHTSA car seat just isn't good enough for us." It was only under pressure from the NTSB that they finally changed their mind on that.

If I could just mention one thing about cost while we're on that subject, the head of the Air Transport Association was quoted in the Washington Post as saying that he is certain that airlines would allow use of empty seats free, as most do now, if a mandatory child restraint rule was issued. So I think we have already had some statements on this from the carriers, that they're going to allow parents to use some seats for free for child restraints. If that's true, some of the cost estimates are grossly inflated.

Mr. LIGHTFOOT. That was the point I was trying to make earlier. In the Apogee study they are basing it on 80 percent of air fares, which airlines don't charge today, and there's absolutely no reason to believe they're going to do that.

My dad told me that the only way to survive was never to assume anything, and I'm very skeptical of people who function on assumptions.

Do you want to say something?

Ms. BIANCHI-SAND. Congressman, if I could just add to Mr. Finucane's comments, in general, our experience has been just a contrast. The FAA's bias has been toward airworthiness of the aircraft and if it gets up, it flies, and it lands properly. Not as much emphasis has been put on this crashworthiness idea, which is where we come in as flight attendants. What we're concerned about, because it seems to be necessary to repeat time and time again, while it's a very safe mode of transportation, there are accidents, and when there are accidents, you need to have crash survivability and crashworthiness issues already regulated and dealt with, and not just assume that it's going to take off and it's going to land and everything is going to be fine, that it's airworthy. So that's been sort of a bias that we have noted.

Mr. LIGHTFOOT. We're within about three minutes of the end of the vote. Could I reserve a little time when we come back?

Mr. OBERSTAR. If someone has further questions, we'll ask this panel to remain.

Mr. LIGHTFOOT. Thank you.

Mr. OBERSTAR. We will recess for the vote now in progress on the House floor.

[Recess.]

Mr. OBERSTAR. The subcommittee will resume at the point at which we recessed for the votes. Mr. Lightfoot had time remaining and further questions to ask.

The gentleman from Iowa is recognized.

Mr. LIGHTFOOT. Thank you, Mr. Chairman. Do you suppose we should explain to our witnesses that we really haven't been voting; this is part of the Congressional Physical Fitness Program that they run us to the Capitol every few minutes?

Mr. OBERSTAR. It looks like that.

Mr. LIGHTFOOT. We do apologize to you for all the interruptions, but unfortunately, there's absolutely nothing the chairman or any of us can do about it, because there's activity going on over on the floor, plus he's been trying to negotiate our air bill, which we should have had yesterday, and heavens knows when we're going to see it now, so it's been one of those kinds of days.

I'm not going to take but just another minute or two. I'll address this question to Jan Brown, who, again, did a tremendous job. The chairman and I both fly a great deal on commercial airlines. We see what you folks as flight attendants have to go through as you get all of us on and in place, and try to get out of the gate on time and off. You've got a tremendous job to do, and you do it extremely well.

Yet, there's this question of, you know, how to we educate parents to risks that are involved in holding a child in their lap? You don't have time to sit down and explain that to them. By the time you get through the safety announcements, which by now I've got memorized, you know, it's time to go. Is there something under the current situation that either the FAA or the airlines or maybe us in Congress could come up with to help with this educational process? I guess maybe I should precede with the questions: number one, is it important that we educate parents to the risks involved in holding a child, and two, if so, how do we do it?

Ms. **Brown**. I think it's very important, Mr. Lightfoot, to educate parents because in looking back at my 232 experience, my first thoughts were "I can't believe this is happening to me." I imagine that without information on child restraint seats parents can't make an educated decision. I think they just feel that it won't happen to them.

Mr. **Lightfoot**. And it usually doesn't, which is the good news.

Ms. **Brown**. And usually it doesn't.

Mr. **Lightfoot**. Is there something that we could do to help in that educational process? I guess I can't feel that there's time to do it when they get on the airplane. It's something that has to be done ahead of time, at least that's my sense. Should the FAA launch some kind of a public relations effort or something of that nature that would help? Would it be worthwhile even?

Ms. **Brown**. We don't want to scare them.

Mr. **Lightfoot**. True.

Ms. **Bianchi-Sand**. Congressman Lightfoot, we had discussed this a little bit earlier, as a matter of fact, the very question of lack of education, and I guess our sense, in the absence of this legislation passing and coming to fruition in the immediate future, is that it should take place now at the level of when you're making your reservation.

People should at least advise you at that point that it would be safer if your child were in a safety seat. They're the ones who know. If the travel agents know that you're traveling with young children at that level, at least some form of education, without frightening people, could be done and could be accomplished, and it would be very useful.

Mr. **Lightfoot**. Even a pamphlet or something they could give them.

Ms. **Bianchi-Sand**. Yes.

Mr. **Lightfoot**. A ticket stuffer or that type of thing.

Ms. **Bianchi-Sand**. Yes, I think that would be a marked change frankly in the whole airline industry where we have tried to sort of de-emphasize safety from the marketing point of view for fear that people would be frightened. I think that we should just treat it as a matter of fact and that it's in their interest and then let them make their decision at this point, assuming we can't get the decision made by someone else.

Mr. **Finucane**. I'd just like to add that under the FAA's analysis, if you educate the parents about the need to use child restraints on airplanes and they can't afford to do it, they might inadvertently switch to automobile travel and be at an increased risk. So under the FAA's analysis, it wouldn't pass a cost-benefit analysis.

Mr. **Coleman**. Mr. Lightfoot, if I could respond to that, we have done two things in that regard. One is that ATA actually produced a small ticket stuffer that says—you may have seen it—"If you buckled your child up at 50, why not buckle him at 550 miles per hour?", and that's been put in tickets. I'm not quite sure where that is, but we've provided that to travel agents and air carriers to put into the ticket envelope.

In addition, when we had a meeting in February, we had invited as one of the participants a representative of the American Academy for Pediatricians, and they agreed that they would make information on the necessity and desirability of having a child safety restraint when you travel by air as part of the briefing materials when they are dealing with new mothers. That's where a lot of mothers learn some of the first things about bringing up children, and they were very pleased at our efforts and said that they would contribute to them to that extent, informing them at that point, particularly first time mothers.

Mr. **Lightfoot**. Thank you very much. I appreciate all of your patience and your testimony and, particularly, Lori, you and Jan for your testimony today. It will make a difference. We appreciate you being here.

Thank you, Mr. Chairman.

Mr. **Oberstar**. Thank you.

Mr. Coleman, the FAA and other testimony before the committee today suggests that in the range of four million children a year under the age of two are traveling annually on our carriers, all carriers combined. What proportion of those children and children of all eligible ages fly at reduced rates?

Mr. **Coleman**. I think most of the fare structure permits children—since the ones under two fly at no cost, basically, the ones from two to 12 are nearly always discounted to some extent, so I think that just about all children under the age of 12 are either flying free or they're flying at a discounted fare, which varies from perhaps free if you're under two to free if it's a particular incentive program.

I believe that the day of the United accident, tragically, there were 50-some children on that airplane, I think, and I think that many of those were flying free, not all of them, because they had to meet to certain tests, as you suggested, but I think very few children who are under 12 fly at anything like the adult fare.

Mr. **Oberstar**. Above 12, it's full fare?

Mr. **Coleman**. In most circumstances. Sometimes it will go higher. They'll go up to 15, and it once again is part of a yield management program that tries to get people to come and fly.

Mr. **Oberstar**. Could you provide figures from your association on that question and be more precise about the number of carriers that offer reduced fares for children at what ages and the proportion of all children traveling who do in fact travel at a reduced fare?

Mr. **Coleman**. Yes, sir.

[The following was received from Mr. Coleman:]

Air Transport Association ata OF AMERICA

1709 New York Avenue, NW
Washington, DC 20006-5206
Phone (202) 626-4000

November 5, 1990

Mr. Joseph A. Italiano
Editor
Committee on Public Works and Tranportation
U.S. House of Representatives
2165 Rayburn House Office Building
Washington, D.C. 20515

Dear Mr. Italiano:

Upon review of the official transcript of the Aviation Subcommittee's July 12, 1990 Child Restraint hearing, there are still two outstanding questions which require additional confirmation or elaboration. They are as follows:

1. QUESTION: In the event that the Federal Aviation Administration mandates that infants under the age of two be required to use child restraints, would the carriers be interested in offering a financial incentive or discount for these infants as opposed to charging a full fare?

   ANSWER: Each carrier determines its own fares, pricing policies and marketing strategies. In reviewing this question with Air Transport Association's (ATA) legal counsel, I have been advised that the ATA, or any third party, is precluded by anti-trust laws from taking part in or the discussion of these pricing activities/strategies. Therefore, I will be unable to provide further information on this topic. If the Subcommittee desires additional information on this topic, inquiries could be directed to individual carriers.

2. QUESTION: Could the ATA provide additional information with regard to the numbers of children who fly and the discounts available for their travel?

   ANSWER: The following data was provided by the U.S. Travel Data Center and is based on a survey they did of air travellers during the summer months of 1989.

AGE	PERCENT	NUMBER
Under 2	14	1.6 Million
2 – 5	22	2.6 Million
6 – 11	28	3.2 Million
12 – 17	36	4.2 Million
TOTAL		11.6 Million

Since these estimated figures are based on a survey done during the summer months when there is increased family travel, the actual figures for a full year would probably be less. A second survey (also from the U.S. Travel Data Center), was conducted in the Spring of 1990 and showed that 16 percent of air passengers are families traveling with children.

The ATA does not compile data about child travel discounts. As I indicated in my testimony, at the time of the United 232 accident in Sioux City, some carriers were offering a special summer discount allowing for children to fly free under certain conditions. During the summer of 1990, at least one carrier offered a special summer travel discount for children which featured a $10 fare available under certain conditions.

Thank you again for your assistance in completing the official transcript record.

Sincerely,

Walter S. Coleman
Vice President Operations

Mr. **Oberstar**. Thank you. Does any carrier now offer a reduced rate for children under two who will travel with a child restraint seat that must use a full seat?

Mr. **Coleman**. I'm unaware of any program along that line.

Mr. **Oberstar**. Okay. Thank you very much.

I want to again compliment all the witnesses on their very fine testimony, especially Ms. Michaelson for threading together a statement that recreates a very painful piece of your life and one that I'm sure will have long term effects on your child, and for Ms. Brown, compliments for doing what you were professionally trained to do that in those few instances, when all of your training flashed before your eyes and you had to put everything that you learned to work, and yet still the powerful force of impact was too great to save that one life. It was not your fault. It was to your credit that you used all of your skill and training to save lives. That should be in your memory. Thank you all very much.

[Ms. Michaelson's prepared statement appears on page 386.]

[Ms. Bianchi-Sand's prepared statement appears on page 117.]

[Ms. Brown's prepared statement appears on page 284.]

[Mr. Coleman's prepared statement appears on page 295.]

[Mr. Witkowski's prepared statement appears on page 391.]

Mr. **Oberstar**. Our final panel consists of Mr. Richard F. Chandler, formerly with the Civil Aeromedical Institute; Mr. Martin Dresner, Assistant Professor at the College of Business and Management at the University of Maryland; Ms. Adele Cover of Fairfax, Virginia; and Mr. Sam Kazman, General Counsel of the Competitive Enterprise Institute.

Mr. Chandler, thank you very much for being with us. You may proceed.

TESTIMONY OF RICHARD F. CHANDLER (RETIRED), FORMER MANAGER OF THE PROTECTION AND SURVIVAL RESEARCH LABORATORY AT THE FAA CIVIL AEROMEDICAL INSTITUTE; MARTIN E. DRESNER, ASSISTANT PROFESSOR, COLLEGE OF BUSINESS AND MANAGEMENT, UNIVERSITY OF MARYLAND; ADELE COVER, FAIRFAX, VA; AND SAM KAZMAN, GENERAL COUNSEL, COMPETITIVE ENTERPRISE INSTITUTE, WASHINGTON, DC

Mr. **Chandler**. Thank you, Mr. Chairman.

By way of introduction, I'd like to give you a little of my own background. I joined the FAA in 1972 as Chief of the Protection and Survival Research Laboratory and remained in that position until my retirement in 1988. I want to make it clear that things I'm saying today do not represent any posture of the FAA nor of any other group who has interest in the child restraint business or the aviation business.

The work of our laboratory in those years was concerned with such things as evacuation, flotation, protective breathing equipment, seating and restraint systems, impact injury prevention, measures of people as it affected these systems, and cabin safety in general. Many of the things we have heard about today as safety improvements originated in our laboratory and finally got into the system.

Shortly after I took over the responsibility for that laboratory, I conducted a series of tests on automotive child restraint systems in aircraft seats. In 1972 recommended that, at least on an interim basis, those seats be accepted for use on passenger aircraft. I was not the first to worry about child restraint on aircraft, but that was perhaps the first time we've worried about providing child restraint on aircraft by using automobile seats.

As we developed these new technologies and attempted to solve problems of safety on aircraft, we were always faced with one of the major problems of defining good solutions—that is, that your solution shouldn't create more problems than the problem you're trying to solve—and we were faced with the fact that it is difficult to define major problems in transport aircraft.

The first line of defense against crash injury, for example, is not crashworthiness but accident prevention, and by and large, at least for the transport aircraft, the accident prevent has worked pretty well. The crashworthiness programs that we were interested in were always second line programs, and I don't really think that's changed. The Crash Prevention Program of the FAA is what is creating the good safety record that the FAA sees.

In regard specifically to child restraints on board aircraft, let me point out that presently there are no child restraints that were specifically designed for use on transport aircraft. The only one that is in service worldwide that I know of is the auxiliary child belt that was mentioned earlier. We tested that system in a cooperative program with Transport Canada, and, quite frankly, it is as injurious to a child as can be.

It concentrates the loads on the child's abdomen, and it places the child where the child becomes a crash cushion for the adult as the adult flails over its own lap belt. It has not been accepted by the FAA, but it is the only restraint currently available for the lap held child. The people who are promoting that restraint are trying to find better ways of doing it, but so far they haven't come up with a better way.

Automobile safety seats are considered because they've received extensive development for automobiles and are widely available in the community. They are not designed for aircraft, so we use what is available to do the best job we can, but it is not the optimum answer. I'd like to discuss a few of the problems with the automobile child seats, some of the things we've discovered as they have been used on board aircraft, and then discuss some operational problems that we see.

First of all, some automobile child seats are simply too big to fit in aircraft seats. That means when a parent brings one of these on board, they may well find that it doesn't fit in the seat they thought they were going to sit in, so at the very last moment they're faced with the problem of finding a different seating arrangement. Once they find that seating arrangement, they may find out that it is very, very difficult to get the automobile seat installed properly in the aircraft seat because there isn't space to reach around the child restraint like there is in the automobile and because airline seats are different.

Once they do get it installed, they may find that it is very, very difficult to remove it at the end of the trip. I've seen time periods of 15 or 20 minutes spent trying to remove a child restraint system from passenger seat. The environment is not an automobile, it is an aircraft.

Now, these things can probably be corrected by relatively minor design changes in either the child seats or the aircraft seats, and there is a group currently working to define those design changes and to get them into service. Please note that, in effect, the FAA is not regulating these seats, NHTSA is regulating these seats, and the FAA has agreed to accept what NHTSA does. That's a problem that has caused some of this confusion.

Part of the problem is that some automobile seats are not at all suited for aircraft. In particular, I'm concerned about the booster seats that are currently stamped as being suitable for aircraft. Booster seats were designed to rectify a specific problem with the automobile installation, and that problem does not exist in the aircraft. The difference between the aircraft seats and the automobile seats actually can cause premature failure of the booster seat and perhaps result in a greater injury potential to the child than would exist had he been seated behind the standard aircraft seat belt.

Another problem that has not been addressed yet is the compatibility of these automobile child restraint seats with the new "16 g" aircraft seats. These new seats are energy absorbing seats. That means they bend during a severe crash rather than remain stiff and break. That's one of their major advantages. Upon bending, they rotate, typically, and current guidelines indicate that rotation up to about 20 degrees may be acceptable. That rotation, together with the normal rotation of the child restraint system in the seat, may cause the child to essentially be propelled head first out of the child restraint. This problem has not yet been addressed and needs to be if we're to make sure these seats work in the severe crash environment.

These are technological problems that can have technological answers. Some of the other problems are not technological, and the problem of cost is one that has been beat to death here, and I won't dwell on it anymore, other than say I certainly agree with Mr. Lightfoot's assessment of the studies. Basically, we have a very fine detailed statistical analysis based on very broad assumptions, and by changing your assumptions, you can change the results of your analysis all over the map. I don't know if any of these assumptions are correct.

My concern is that some of them may be correct. Both sides are making assumptions, one side is likely to be more correct than the other. If the assumptions put forth by the FAA tend to be more correct than the assumptions put forth on the other side, well, then we may have done the child a disservice. I also disagree with those people who say, "Look, we're just talking about aircraft safety." No, we're talking about child safety. Child safety in the United States. I don't think we can ignore the possible ramifications of the possibility of driving some of these people into a more hazardous highway environment. We're looking at child safety across the board, and the negative effect could occur fairly rapidly.

Most of the studies I've seen seem to indicate that the benefits in child restraint systems in aircraft would be one life per year or less. One additional life lost in the highway safety statistics won't even be noticed, but that one life could totally negate the advantages of the child restraints in the aircraft. It's a very small margin we're playing with, and the risk of error is there.

The second problem, which is not a technological problem but has been alluded to, is the problem of getting a child out of the seat during an emergency evacuation. If the seats are mandated, it is most likely that the air carriers will select and furnish the seats for their airlines and train their people in the use of those seats. This will then avoid the problems of incompatibility I mentioned, and you can be sure that the seat will work in the airline. A good thing.

But in doing this, the user of the seat, the adults traveling with the child, may well be faced with a strange seat that is different than the one they use in their family automobile. Now, in our research and in our accident studies, we find that people misuse safety equipment at an alarming rate in an aircraft emergency. Even with one-on-one instruction, they misuse it, and it won't take many problems in emergency evacuations before we again negate the rather small benefit that we're going to get from using the child seat in an aircraft seat environment.

The loss could be not only of the child but of the adult who spends a few seconds or minutes trying to get the child out of the seat during a burning aircraft crash, or it can be of additional passengers who try to help. These things happen in a matter of seconds, and, again, the problem could be more serious than we have alluded to.

The final thing I'd like to address is the presumption that everybody is well restrained on board the aircraft except for the child under two. Well, I hate to have a rather negative attitude here, but that just isn't the case. There are many other categories of people who are not well restrained on board aircraft—pregnant women, paraplegics, the elderly, and I could go on.

So I'm a little dismayed that we are addressing one narrow class without addressing the problems of all these other people who don't have optimum restraint on board the aircraft. I'm particularly distressed because the better restraint for all these classes of people has been known for 40 or 50 years. It's been an item of controversy, just as child restraints are. That solution is rearward facing seats.

Yes, indeed, rearward facing seats provide the average adult better protection. They provide the paraplegic, the pregnant woman, the elderly better protection. You have broadly distributed support, you aren't loading the lap belt, and you aren't flailing around the lap belt and hitting your head on something in front of you. It provides good protection for the small child. It could possibly even provide protection for very small children, those under two, since they would be supported by the seat back rather than the seat belt, in just exactly the same manner that many of these child restraint systems we're talking about support the child.

My concern is that we may be prematurely initiating activity to mandate child restraints and thus freeze the state of technology in child restraint systems. We are also ignoring these other classes of people that also have a solution out there, ready to be mandated. I can assure you that approach won't be any easier than the one you're going through now, but it certainly would have a much broader application.

Thank you. I'd be willing to answer any questions or provide more help.

Mr. Oberstar. Thank you very much for your thoughtful presentation and well prepared statement you've submitted for the committee record.

Mr. Oberstar. Mr. Dresner.

Mr. Dresner. I'd like to thank the chairman and members of the subcommittee for inviting me to testify here today.

As the chairman stated, my name is Martin Dresner, and I am Assistant Professor at the College of Business and Management, University of Maryland. The basis for the testimony I am presenting today comes from a research paper my colleague, Bob Windle, and I wrote as part of our ongoing research into air transport, copies of which we have presented as written testimony for this hearing.

[The study referred to, previously entered into the record by Mr. Anthony Broderick, may be found on page 188.]

Mr. Dresner. Previous studies concerning mandatory child safety seat regulations in air transport, such as the study conducted by the FAA, have attempted to weigh the costs of such a system against the benefits. This cost-benefit approach is often subject to criticism because of the difficulties of measuring the dollar value of the costs and benefits, particularly when the benefits are lives saved.

What we have done in our study is show that there are no benefits in terms of lives saved to mandatory child safety seats in air transport. The major premise of our paper is that the institution of mandatory child safety seat regulations will increase average fares and divert air travelers to the less safe highway system, ultimately resulting in a net increase in fatalities among the traveling public. In other words, we show in our paper that mandatory safety seat legislation will result in an increase in lives lost.

Currently, adults with children under two years of age may take their children onto flights without separate paid tickets and have the children sit on their laps. In effect, the children fly for free. Suppose new regulations were implemented requiring adults to buy tickets for their children under two and to put them into safety seats on airplanes? The FAA has estimated that this requirement would raise the average fare for a family of four with one child under two years of age from $296 to $358, assuming the additional ticket is bought at half price.

Based on diversion statistics and modal choice work done by economists, we estimate that this increased price will cause 300,000 children and their accompanying families to be diverted annually from the air system to the highway system. This means that 300,000 families, or 1.2 million passengers, based on an average family size of four, will choose to drive to their destination instead of to fly.

Data in the Statistical obstract of the United States indicates that the highway system has a fatality rate nearly 50 times the fatality rate of the air system. The number of lives lost by air travelers diverted to the highways is likely to be many times the number of lives saved by the increased effectiveness of the child safety seats in airplanes. The exact number of additional lives lost will depend on the number of people diverted to the highways and on their driving and vehicle characteristics.

If you turn to Table 1 on page 10 of our written testimony, I can give you an idea of the number of lives that are expected to be lost due to the implementation of a mandatory child safety seat policy. The center column in the table represents the most probably estimate of additional lives lost due to the implementation of the policy under various assumptions regarding driver and vehicle characteristics.

The first row in the table contains our base case. The base case assumes that the mothers and fathers diverted from air to auto have driver profiles identical to the profiles of the average driver. Based on this assumption and our most probable estimate of traffic diversion, 1.2 million passengers, the institution of mandatory child safety seats will result in the loss of an additional 11.2 lives annually.

Some people, however, have questioned the average driver assumptions for diverted airline passengers. Maybe these passengers are better than average passengers. In order to see how robust the results are to this type of criticism, a conservative base case was developed. For the conservative base case, it is assumed that the diverted drivers fit an average airline passenger profile.

The average airline passenger is older than the average driver and is statistically a safer driver. Secondly, it is assumed that two of the passengers are traveling in the back seat of a car, which is statistically safer than the front seat. Thirdly, it is assumed that all travel takes place on the much safer interstate highway system. Finally, it is assumed that the diverted drivers do not consume any alcohol before or during their trip.

The results of this conservative base case are presented in the fifth row of the table. Even under these conservative assumptions—and I stress the word conservative, since at least two of the assumptions are unrealistically conservative—the mandatory child safety seat requirement would result in an additional 1.5 lives lost annually.

Finally, to be even more conservative, the effects of three additional assumptions regarding driver and vehicle characteristics are examined. The first assumption is that all diverted families travel in big cars, 700 pounds heavier than the average. Secondly, it is assumed that all families are diverted from short airline trips, one-half the average airline trip distance. Finally, it is assumed that all diverted passengers, both children and adults, wear safety belts.

Each of these assumptions is added separately to the conservative base case. The results are presented in the last three rows of the table. Even under these ultra-conservative assumptions, mandatory child safety seats in air transport are expected to cost lives.

An alternative suggestion to requiring parents to pay for extra tickets for their young children is that these tickets should be provided by airlines to families for free. The results of such a policy, which we present in greater detail in our written testimony, would in fact be similar to those presented in Table 1. If the airlines are forced to give away seats for free, this would drive up airline costs, since many of the children would occupy seats that otherwise could be sold to fare paying customers. The airlines would likely pass these costs on to the traveling public in the form of higher fares.

Again, the increased fares would force diversion from the air transport system to the highway system. Based on a conservative estimate of the sensitivity of passengers to price changes, we estimate that under these free seat rules 635,000 passengers would be diverted from air to auto. If we assume the diverted drivers fit the average airline passenger profile and travel to their destinations exclusively on interstate highways, the traffic diversion would result in a net increase in lives lost of 1.6 per year.

Another alternative method of implementing a mandatory child safety seat policy is to require all children under two to be in child safety seats but allow them to occupy vacant seats for free. Parents would then only have to buy tickets for themselves and for children two years of age and older if vacant seats are available for children under two. This policy would allow, in effect, children under two years of age to fly for free on a stand-by basis.

We do not believe this stand-by option is viable for most traveling families. Families would face a great deal of uncertainty in traveling to their destinations. Parents could very well arrive at an airport with their children and find there is no room on their flight for their young children. They could lose all or part of the value of their tickets if, as is likely, the tickets are non- or only-partially refundable.

Even if airlines refund non-refundable tickets for families who do not all get seats, there is no guarantee that seats on alternative flights would be available. Finally, it is likely that there will be few stand-by seats available during the times such as Thanksgiving and Christmas when many families wish to fly.

In essence, under this alternative, the whole family must fly stand-by. Flying stand-by involves increased costs in terms of waiting time and inconvenience. These costs are likely to be as effective in diverting families to highways as are increases in fares. While it is more difficult to quantify the number of passengers diverted under this scenario, our previous results indicate that even when small numbers of passengers are diverted, the number of fatalities to the traveling public will increase.

The bottom line is that under any reasonable assumptions, mandatory child safety seats in air transport will increase fatalities. In other words, there are no benefits in terms of lives saved to mandatory child safety seat regulations. There are, however, costs to requiring the child safety seats. These include the increased fatalities, which I have been talking about, as well as increased injuries—the injury rate on the highway system being much greater than the injury rate in air transport—the loss of comfort and convenience to those diverted from air to auto, and the lost opportunity to families discouraged from flying to their destination and too inconvenienced to drive.

In summary, mandatory child safety seats in air transport is a bad policy. A much superior policy is to ensure the optional use of child safety seats. This alternative policy does not result in the diversion of travelers from air to auto and marginally decreases the fatality risk for children using the seats on airplanes.

That concludes my prepared statement, and I would be pleased to respond to any questions.

Mr. **Oberstar**. Thank you very much, Mr. Dresner, for an obviously very comprehensive project that you undertook and the very significant documentation you've developed.

Ms. Cover.

Ms. **Cover**. Good afternoon, members of the committee. I'm Adele Cover, and it's a privilege to be here today to present my views as a family member among the flying public. I'm a mother and a grandmother, and I'm also a fairly savvy consumer. The May 23rd Washington Post article titled "NTSB Recommends Adoption of Airline Child Safety Seats" triggered my consumer alert focus with its subtitle "Era in Which Baby Rides on Lap for Free May Be Over."

I then submitted the following letter to the editor of the Washington Post, which was printed on June 2nd:

> One Half Billion Air Fare Rise. The National Transportation Safety Board recommended yesterday that the Government require all infants and small children be placed in child restraint seats aboard airliners.
>
> Take out your calculators, folks. That same article said that between 5,000 and 10,000 children under two travel on airliners every day. Figure between $100 and $200 per fare, and it's pretty easy to come up to well over half a billion dollars. This money will go right into the airlines' pockets and be paid by mostly young parents.
>
> What in the world ever happened to cost effectiveness? How many lives might be saved? I've seen no estimates. There are always plenty of estimates of lives saved if we drive a car at a certain speed, use seat belts, or have air bags in our cars. Why no estimates now? Maybe a few lives might be saved over a period of many years. How many more might be saved if that much money were invested in better radar and computers for airports?
>
> The subtitle of the article was "Era in Which Baby Rides on Lap for Free May Be Over." Is this what it's really about—money, not safety?

With the preceding letter as a background, I respectfully submit to the members of the Congressional Subcommittee on Aviation the following. If it can't be shown that a significant number of babies' lives will be saved with the use of safety seats, then the use of safety seats on airliners should not be made mandatory. It is absolutely unconscionable to extract millions of dollars from parents who don't want to purchase unneeded protection. Safety seats should be made available for parents who wish to use them for their babies. In this instance, parents would be required to pay the extra air fare for their baby's ticket.

Through the legislative process, if an attempt is made to minimize the appearance of a large fare rise for young traveling families, please consider the following. Ticketing based on stand-by or any other last-minute arrangement would be unacceptable for families flying with babies. Planning and timing are absolutely essential to traveling with little ones.

Please allow me to interject a personal point or two. When my children and grandchildren arrange to travel by air, my only worry is about their ability to pay for their tickets. My concern about their safety is quite minimal. When they elect to travel by automobile to their destination, I worry throughout the duration of their trip about their safety.

The question was asked here on the panel, once a child reaches age two and is required to pay a fare, will he never fly again? In my family's case, my grandchildren, now six and four, who live on the West Coast, came to see me every six months before they were age two. Since then, it's been once every three years that that family of four has traveled east, and I don't know of any fares from Seattle that are reduced for ages 2 to 12. I just don't know about that. That was not in my family's agenda with their travel agent.

I would encourage more research on the device to allow a parent with a baby in their lap, a specially designed restraint, perhaps one that is strapped to the side of the parent's body so that the parent wouldn't be crushing the baby by leaning forward over the baby. I'm not an engineer, but I'm sure if we can go to the moon, we can take care of our babies in the air.

Thank you for your time and interest in allowing me to share my views with you today.

[The prepared statement of Ms. Cover appears on page 384.]

Mr. **Oberstar**. Thank you very much. I certainly concur with you that with all these wonderful technologies, we ought to be able to find something simple, practical and workable on earth to take care of passengers on suborbital flights. You said it very well, and you wrote a very thoughtful letter to the editor for the Washington Post, and it caught our committee's attention, and we're glad to have you here with us today.

Mr. Kazman.

Mr. **Kazman**. My name is Sam Kazman. On behalf of both the Competitive Enterprise Institute and Consumer Alert, I would like to thank both the chairman and the subcommittee for this opportunity to testify on the issue of mandatory child seats in airplanes. Rather than read my submitted testimony, I will simply elaborate on some of the points therein.

When it comes to using child seats on planes, American consumers are empowered to an unprecedented degree. After all, there are hardly any families with young children in this country who do not today either have their own child seat or have access to a child seat, and if any of these parents wish to fly, and if they want to assure themselves of being able to use that child seat, the way is very open to them. All they have to do is buy a ticket.

So the question at this hearing is, why take this choice away from them? After all, there is very good evidence that if you take away that choice you may perhaps improve air safety to some very small degree over a number of years, but you'll be drastically reducing overall safety. Now, it's true that you might question the assumptions upon which the various studies on this substituted air travel are based, but if you look at the assumptions being made by the people on the other side of this debate, those who push for a mandate of child seats, you need a total leap of faith to accept their assumptions.

Their first assumption is that prices will not go up for young families for one or another reasons. I challenge anyone in this room who takes that position to personally guarantee to reimburse a family that does have to pay to take a child under two on an airline, that has to pay for a separate ticket. I challenge one of the proponents to guarantee to reimburse them out of their private pocket.

The second assumption is that, yes, perhaps air fares will go up, but it won't really matter, because no one will stop flying just because they now have to buy a ticket that they never had to buy before. Let me read to you from a parent who wrote in to both Congress and the FAA describing herself as "one concerned young mother speaking up for all the other mothers who are much too busy caring for their babies to write letters to their Congressmen."

After setting out in great detail her ability to fly with her young child because she can take that child for free, she says, "We count on these visits while our daughter is young and can fly free because I don't anticipate being able to travel for a few years after our daughter hits the magic age of two, when we must pay for her seat." Is this woman a liar? I submit that she's in a much better position than any of you people are to know exactly how she is going to be able to deal with higher prices on the limited budgets that almost all young families face. After all, unlike the Federal Government, these families do not have printing presses in their basements upon which to run off money to pay their bills.

Finally, we heard the statement that the likelihood of a fatality on an airline is really irrelevant. The statement was made "If my baby dies, I don't give a damn about the odds." Now, that is a personal statement with which I can't argue, but I can say that it is not a prescription for public policy. Certainly, if I were to come before you and say, look, I entered a $1 million lottery and I bought the winning ticket and I won and so the chances for me are 100 percent, yes, I'm happy about that, but that's not any basis for me to say therefore let us all become gamblers.

So we come back to the question why is this consumer choice threatened? Remember, any consumer now who wants to use their child seat on an airline simply has to buy a ticket, and any airline that as a matter of policy wants to prohibit children from sitting on their laps is free to do so. There's no reason for them to band together and ask the Government to prohibit their ability to give away free fares.

The real reason, I believe, is this. What we have here is a contest between national headlines involving a one-in-a-million plane crash at the expense of everyday tragedies that will only appear on the back pages of local newspapers. We've heard a lot about the Sioux City crash. In July of 1989, the Sioux City airline crash was not the only accident in Sioux City that involved children.

According to the Sioux City Journal, two weeks before that two young girls were seriously injured in car accidents. Their parents are not here. I don't think anyone here knows about that. And if in the future as a result of a mandate of child seats several more such accidents happen, no one is going to know about that either. These will be faceless statistics, because they are everyday tragedies that do not make the national news, and we won't have hearings about it, and we won't have their parents in this room complaining about it.

It is a debate really between national headlines and a very mundane but very tragic occurrence that will not strike the same chords as a plane crash, and we know that there will be more of such crashes occurring on the roads if the price of airline travel becomes higher. Do we know exactly how many? No, of course not. But given the margins we're playing with here, I suggest that we be humble enough about our own state of knowledge to leave this issue where it is right now and where it belongs—in the hands of the people. Thank you.

Mr. OBERSTAR. Thank you very much, Mr. Kazman. I appreciate your testimony and that of all the members of the panel, and the chair will at this time recognize the gentleman from Iowa, Mr. Lightfoot.

Mr. LIGHTFOOT. Thank you, Mr. Chairman, and thank all of you as well for appearing this afternoon.

Something has occurred to me as we've listened to this discussion on both the pros and cons of the issue, and as we get into this discussion about who's going to pay and what's going to pay and so on and so on, if we take a very whole cold, hard, capitalistic look at this thing, the airline is in the business of providing transportation from point A to point B. It costs them certain amounts of dollars to do that in fuel, flight crews, baggage handlers, ticket agents, insurance, the whole bit. It's a service that the airline provides which, in a free enterprise system, they have every right to charge for that service to do so.

Quite frankly, the airlines have been giving parents a bonus and at the same time accepting tremendous amounts of liability risk by allowing children to fly free to start with. So I don't think all this rhetoric that the airlines are in this to make a lot of money carries a great deal of weight.

I would challenge you, Mr. Kazman, that the next time we have a child killed in an airline that you reimburse the parents for the loss of that child. I think that we're getting off into some areas that I'm extremely uncomfortable with.

Mr. Chandler, you made some very, I think, good points in regard to some of the problems that can be encountered with using child safety seats in an airplane. They weren't designed to be used there in the first place. I totally agree. I hope you're aware that in the legislation that we're proposing it merely states that an FAA-approved child restraint would be used. We did that on purpose to allow the FAA latitude to develop something better than the car or child safety seat without going through a lot of bureaucratic maneuvering and so on to get it approved. I totally agree with you that the child safety seats that we're using in automobiles probably are not the best solution in any way, shape or form, but, unfortunately, it's the only device that's been approved with the DOT at this point in time.

If we had a suitable restraint that had been developed specifically for aircraft use that possibly even didn't require a separate seat, under that kind of a scenario, would you be more supportive of a mandatory requirement than you are now?

Mr. CHANDLER. Yes. Let's not lose the perspective that I have been advocating the use of automobile child seats for almost 18 years now, even with their deficiencies. Certainly, a better economically available, all the good features child restraint system, if available, would indeed eliminate a lot of the problems here.

At the present time, such a system is not available, and if a requirement were mandated at the present time, it is unfortunate in the industry that we are dealing with that mandate that would require a solution with the state-of-the-art technology today, and that solution would be automobile child restraint systems, and from that solution would become an investment in child restraint systems and an investment, even more important, in training of the cabin safety personnel, the cabin attendants that deal with the passengers.

That is a significant investment that will then make it very, very difficult for any of these new devices which may be forthcoming to break through the system. Essentially, the effect of mandating it "now" will say use "now" technology, and once that's done, it's going to be very, very difficult to break through that. Indeed, that is one of the hazards of a mandate that will have a fairly rapid application time.

There are scores of new ideas being brought forth as a result of the publicity from the Sioux City crash. These ideas are not developed at the present time. Some of them we've looked at many times before and rejected, but some of them are indeed new, and a premature mandate of the use of a system will essentially fix the state-of-the-art where we are now.

Mr. Lightfoot. Do you know a Dr. Richard Snyder?

Mr. Chandler. Oh, yes, very well.

Mr. Lightfoot. He's been, what, some 30 years as one of your fellow researchers on safety and so on?

Mr. Chandler. Yes.

Mr. Lightfoot. I understand that Dr. Snyder has a little different approach to this than you do, that he supports the mandatory requirement. I'm sorry he's not here and we can't ask him why. Do you know why, since you're well acquainted with him?

Mr. Chandler. Okay, yes. Jerry Snyder is a very, very busy person and is probably doing at least three other things today, all of which he's getting paid to do, and that's a highly motivating thing to stay in that type of business. Other than that, I'm sure he would relish being here and giving his opinions. Incidentally, Dr. Snyder and I usually agree once we have the opportunity to talk things out.

Mr. Lightfoot. I appreciate that. You've been very active in the car safety restraint thing, and I brought this up earlier, and CRS did a study, and this relates to automobile, not aviation, but I think it points out something that hasn't been discussed today, and basically it says regulation in the child restraint area is viewed somewhat differently. Infants and young children are almost completely dependent upon others for their well-being, and after a number of court challenges, it has been determined that the State has a right or an obligation to ensure the protection of infants or small children because they cannot adequately protect themselves.

Apparently, the courts across our land have ruled that the State has a right or obligation to ensure the protection of infants and small children because they cannot adequately protect themselves. That was the reason I asked Mr. Broderick the question which he couldn't respond to because he's not an attorney, and I totally understand and appreciate that, does the FAA feel that in the court of law that they could be held liable because under their regulations they're not providing protection for everyone, they're discriminating against children? I would think this might be something that the rule makers should take into very serious consideration when they're looking at this rule as to what the legal ramifications might be as well.

I'm running out of time. Very quickly, Mr. Dresner, I appreciate your explaining your very thoughtful dissertation and your research work. Again, I have a great deal of difficulty with assumptions. My dad told me once never to assume anything, and I learned in this political business you don't assume the volunteers will put the signs out, you don't assume the phone calls have been made, because if you assume that, you might as well assume you're going to be looking for a new job somewhere, because it usually doesn't get done.

I really envy you folks in academia who can put the time into these things and come up with them, and yet really don't have to accept the responsibility, if your numbers are wrong, you know, so what, but we're dealing with Lori Michaelson and Jan Brown and real live, honest to God people, and the decisions we make are very critical to what happens to them in the future, and I will tell you that if I had even the slightest feeling that this legislation was going to endanger a child in any way, shape or form, as many of you have alleged it's going to do, I would go to the chairman and ask him to pull the bill immediately.

But I have not seen, in my opinion, anything other than assumptions, and when you listen to people who are flight attendants who have been through accidents; when you talk to people who are parents who have been through these kinds of tragedies, it becomes extremely difficult, for me at least, to feel that an assumption should take precedent over another human being.

Ms. Cover, you made the statement that if you felt significant numbers of deaths were occurring that maybe we should do something. What's a significant number? How many would have to die?

Ms. COVER. I really can't answer that. I couldn't put a figure out there. I think my point was that I haven't seen any figures at all, really, and even in attending this session, I haven't heard any real statistics. I've heard one a year, something like that, but that's just sort of assumed. I really don't see any definite statistics on this, although the FAA and the National Transportation Safety Board can tell you when a pilot sneezes on the way down.

So I think that a good beginning would be to find out what really the statistics are so that when you see an assumption, you'll be able to find some credence in it.

Mr. LIGHTFOOT. Of course, the basic problem with statistics, since the airlines provide as a free service to parents letting children under two ride, no one keeps track of them. They don't know how many fly. That's purely an assumption.

If we use the figure of 10,000 a day, that's about, what, 3.6 million a year? Some of the airlines tell us there are roughly 5,000 kids that fly a day, so that gets it down to 1.5, which throws all of Mr. Dresner's numbers off, because we're working with different assumptions again, and until such time as we start recording the number of children that actually ride free, we don't have a statistic.

Ms. COVER. Right.

Mr. LIGHTFOOT. So maybe the airlines should start charging for everybody so we've got a statistic.

Ms. COVER. Well, maybe the airlines should just start counting everybody on their planes.

Mr. LIGHTFOOT. Oh, no, only people that pay have to be reloaded. They're required by law. It has to be on a log and a manifest sheet, but since the child rides free, they don't show up. That's a service that the airline provides to the parent to allow the child under two to ride free, and therefore they don't appear on a manifest log.

Ms. COVER. Is there a possibility they could be asked to put the children on the manifest log?

Mr. LIGHTFOOT. I suppose we could, but then again it would throw the whole system off, and why should they keep track of somebody that they're providing a service for free of charge? This is their rationale, and I agree with them. You know, it's putting more of a burden there.

Again, I appreciate all of you coming, and I realize that we've got a totally different opinion on this issue, but that's what makes this country work, that we can have differences of opinion.

But I really, Mr. Chairman, appreciate your help with the hearing, and again I guess maybe going back to Mr. Kazman's statement about the two people that were killed in Sioux City in the automobile, I'm from Iowa, that's my home State, and we have a State law that says you have to have a seat belt on in an automobile, and if, unfortunately, those two young people were killed because of a car accident, and they did have on their seat belts, then we probably need to look into that a little further and see what the problem is there.

I don't think you can compare that to a small child who cannot make a decision for itself, who is tossed about in an aircraft in clear air turbulence or in a crash. To me, there's no correlation between those two issues.

Again, we do appreciate you being here. We appreciate all the other witnesses, and, Mr. Chairman, thank you, and I yield back my time.

Mr. OBERSTAR. Thank you very much. I do again want to compliment the gentleman from Iowa in his persistence on this issue. He has been very, very supportive, he has made it a very passionate concern and one that he expresses with great eloquence.

Mr. Dresner, what prompted you to undertake this project?

Mr. DRESNER. My colleague, Bob Windle, and I are both in the Department of Transportation, Business and Public Policy at the College of Business and Management, University of Maryland, and we like to undertake interesting research in air transportation. Air transportation is both of our fields.

Mr. OBERSTAR. Now, I'd just like to revisit a statistic that you used, because it answered a question, I think, that I was going to ask, and the question would be, what would be the effect on the diversion to highway travel cited by other witnesses if the cost for the use of child restraint seats were reduced or eliminated all together?

You said that you had analyzed that issue and raised the prospect of transfer of costs to other passengers increasing ticket costs and that would drive some 635,000 passengers to the highways.

Mr. **Dresner**. I guess in economics we assume that there's no such thing as a free lunch, and I think that in fact you just can't assume that if airlines are forced to provide seats for free to all children under two years of age that there is no cost to that. We feel that there is a cost to that, and we've looked at what that cost will do to average ticket prices paid by the traveling public, and they'll go up, and we feel that our best estimate is that 635,000 air passengers will be diverted to the highway system.

Mr. **Oberstar**. All right. Now, is that four million figure, children under the age of two traveling annually, is that a fairly solid figure?

Mr. **Dresner**. Well, we used the FAA estimate.

Mr. **Oberstar**. You didn't question that estimate, you just used their number?

Mr. **Dresner**. I think that getting back to what Representative Lightfoot was saying is that you have to make certain assumptions when you conduct an analysis. I think that his skepticism is very well-founded. What we did, after did out initial base case, was look at our assumptions and see whether or not our results change if in fact our assumptions are not correct.

So based on the four million figure that the FAA had, we estimate that 1.2 million people will be diverted to the highway system. But, what happens if that four million figure is overstated? Well, we looked at diversion figures as low as 200,000, one-sixth our most probable estimate, and still find that there is no benefit in terms of lives saved to mandatory child safety seats in air transport.

Mr. **Oberstar**. As I suggested to the ATA witness earlier, I would fairly say that parents are not unwilling to pay something for a child under two, recognizing it takes up a seat and all that. We went through that with four children, and we traveled, and we kind of bit our tongues and said this really isn't very safe if something happens, if you have turbulence in the air, if the aircraft drops, and FAA, by the way, ought to be something about children crawling around in airplanes in flight when you could have mid-air turbulence and a sudden drop and the child bounces up to the ceiling.

That isn't very well covered by current FAA rules, but nonetheless, I don't think we would have been unwilling to pay something to share that cost, and now as we've gone on and the children have grown, they're air travelers in their own rights, so there's a returning benefit to the air carriers as well. It isn't just this money down the drain, we lost that passenger seat. That person is going to continue to be a revenue passenger. If he survives a crash, he's going to continue to fly.

So have you looked at what possible combinations of reduced fare incentives by the carriers might do to that traveling population?

Mr. **Dresner**. We calculated our results based on children under two years of age paying a fare one-half the average adult fare and, as I said, in our paper we also looked at the possibility of in fact the airlines giving away these tickets for free to children. We looked at a few different scenarios.

Mr. **Oberstar**. Did you come up with some conclusions?

Mr. **Dresner**. In each case, we came up with mandatory child safety seats resulting in a net increase in fatalities to the traveling public.

Mr. **Oberstar**. I'll have to review that. I did not get to those parts of your report, and I will have to review those factors and have some thoughts further about it.

Ms. Cover, you described yourself as a very careful bargain hunter. Would you as a parent use a child restraint seat if the airline provided the seat?

Ms. **Cover**. Yes, I think I would.

Mr. **Oberstar**. Would you do so if the ticket were free?

Ms. **Cover**. Yes.

Mr. **Oberstar**. Would you do it if there were reduced costs, let's say half price?

Ms. **Cover**. Half price would be fine.

Mr. **Oberstar**. There's some point at which you——

Ms. **Cover**. Right. There's a point at which——

Mr. **Oberstar** [continuing]. Are willing to pay——

Ms. **Cover**. I would weigh one against the other. My budget would be, you know, the point. That would dictate to me where my point would be, but I would think as a parent that a half price fare would be fair.

Mr. **Oberstar**. And in my opening remarks, I referred to the situation if prices get too high that the parents of young children might be dissuaded from coming to visit grandmother, and grandmother might have to come visit them.

Ms. **Cover**. Right. I did. Lots of times.

Mr. **Oberstar**. In some cases, that's not possible, as in the case of my mother, who is living on a very small Social Security income, and she can't do that very easily.

Ms. **Cover**. Right.

Mr. **Oberstar**. She visits one set of grandchildren, and she's got to visit the other two, and she doesn't quite have the money to do all that. So at what point, just thinking back now as a mother of young children, tight budget, what point does it become prohibitive to take that infant under two on a flight which you have to pay some amount? At what point does that become prohibitive?

Ms. **Cover**. I would think for me that it would be a half fare point, but that would be just for me. Everybody's budget is different, everybody's priorities——

Mr. **Oberstar**. Each one is going to be different, right. But we have you, we don't have all the other folks. We have you, and you wrote a very thoughtful letter, you've given a great deal of personal thought to that, and we wanted to get your instinctive reaction.

Ms. **Cover**. Before I came today, I thought that it should be a given, but having sat here and listened to the testimony, I'm realizing that it is now a given, and it's an unsafe given. I think that ideally it would be great if we could keep the baby with the parent until they're at age two with some kind of a restraint that would be safe in the parent's seat. Next to that, I suppose that a half price fare would be fair.

Mr. **Oberstar**. It would be a good inducement. Thank you.

Mr. Chandler, from your long experience with CAMI and time now to think freely and creatively, do you feel it's possible to design a seat that the air carriers could just simply put in and withdraw on aircraft that's designed specifically to hold a child under two?

Mr. **Chandler**. Oh, yes, undoubtedly. The problem is not with a seat——

Mr. **Oberstar**. Would you pull the mike up a little closer, please?

Mr. **Chandler**. The problem is not with a seat that can be put in and installed easily or such. All those things can be handled by technology. The real problem appears to be when you try to design protection for the lap-held child and allow the child to remain in the lap. Now, that is not a new problem, and we have recognized that as a problem or many years, and no good answer has yet been forthcoming for the lap-held child.

Mr. **Oberstar**. You've described that very well, and I think that is very real and a genuine concern. Some people who have improperly adjusted their automotive seat before you have the shoulder harness put that seat belt up around their middle and suffered severe consequences. I was in a small airplane crash, single engine airplane crash, with another passenger who didn't have the lap belt around the hip sockets but had it up right around the stomach and suffered a four-inch wide welt across the mid-section and was in the hospital for many days and escaped far more serious injury by the grace of God.

So you're right, the lap-held child with a belt or restraint of some kind is, I think, just inherently dangerous. So a seat specifically designed, either one that you carry on or one that the airline can put in place, to hold a child under two can be done and would provide the maximum safety?

Mr. **Chandler**. Most assuredly. It can be done. Whether it will provide the maximum safety or not is a matter of question. I still feel that everybody would be better of in rearward facing seats, including small children, because they provide optimum protection for flailing and a lot of other potential crash problems.

Mr. **Oberstar**. That, too. Clearly, the automotive seat that is rear-facing is the safest for a child.

Mr. **Chandler**. Yes.

Mr. **Oberstar**. All right.

Mr. Kazman, I listened with great interest and thoughtfulness to your comments and the questions you raised about the financial consequences. I just have to engage in a thought for a moment. In 1956, Dwight Eisenhower proposed the establishment to Congress of the interstate highway system, saying it was needed for three purposes, the principal of which was safety. At that time, we were killing 38,000 people a year on the Nation's highways.

In the 30 plus years since then, we have spent from the Highway Trust Fund $198 billion, and $95 billion of that has been spent on the interstate highway system, principally because we wanted to build the safest highway possible. We're still killing about 40,000 people a year on the Nation's highways, a little bit more than that, about the number every year that were killed during the Korean conflict.

But if we didn't have that interstate system, if we hadn't put that money into safety, we'd be killing over 108,000, maybe 110,000 people a year by current estimates. We were willing to spend an enormous amount of money taken out of the drivers, out of the users of the highway system to save lives. I think it makes sense to do what we have done. While there may be some costs, I think we have to face up to those costs and find a way to get around them, rather than throw up the cost as some psychological barrier that can't be overcome.

Mr. KAZMAN. May I respond?

Mr. OBERSTAR. I certainly want you to respond.

Mr. KAZMAN. This is not a tax issue. This is not being proposed as a bill to set up a Government fund to pay for children flying on airlines or flying with child seats on airlines. This is an issue of restricting a choice that consumers now have and that they are fully capable of making. The real benefit, I think; of the interstate highway system was that it made travel possible, and with travel come risks, and while we can try to minimize those risks, there comes a point when the activity itself is important.

After all, a child's life is priceless, but we still allow our children to play in short sleeves in the sun, though that increases their risk of getting skin cancer, we eat charcoal broiled hamburgers, though that has its risk of stomach cancer from benzopyrenes, we drive out to a pizzeria rather than having a pizza delivered to our house because we want to, even though there might be a risk.

And there is a risk here that is making the headlines, but there is a consequent risk once you eliminate that that is not going to make the headlines, and I sincerely submit that that is the driving force behind this debate. This is not a cost-benefit issue, this is a safety versus safety issue, and I think all the evidence, all the documented evidence put in shows that this will not save lives, it will kill people.

But those people will not be on the front pages of the newspapers, they'll be in the obituary section, and I sincerely suggest that given the power that consumers now have, if you want to educate them, go ahead and do that, but the choice should stay in their hands on this question.

Mr. OBERSTAR. Do you dispute that it's possible to design and install on aircraft a safe seat for children under two?

Mr. KAZMAN. I don't dispute that at all.

Mr. OBERSTAR. So it's possible?

Mr. KAZMAN. It is possible.

Mr. OBERSTAR. And then the question is, what is the cost of doing so?

Mr. KAZMAN. And what are the other risks that you create with that? After all, you can make a house so burglar-proof that you can't get out of it if there's a fire. Certain types of attempts to minimize risks have effects in terms of increasing other risks, and this is one of those cases. Unless Congress itself wants to fund this program, and I do not propose that they do that, but unless you want to do that, putting the cost of it on people who have the choice of how they'll travel is going to have the consequences we've discussed.

Mr. OBERSTAR. All right. I have to differ with your conclusions, because I think that experience has shown where there is a problem and a willingness to deal with that problem, there's a way to overcome it. We did in the interstate highway system. We were willing to invest the money, and the air carriers themselves have an interest in making it possible for families to fly and to fly at affordable rates and to fly in a manner that is safe.

If indeed air travel is going to continue to be the safest mode of travel, and goodness knows we spend several billion dollars a year making it safe in the air traffic control system and the operation and maintenance of that system and the vast regulatory body that imposes on the air carriers to maintain their aircraft and build into them redundant systems, then there surely is a way to deal with this one very small—in relationship to all the other technologies—technological question. Surely there is a way to do that and to do it at a reasonable cost.

That, I hope, will be the outcome of this hearing. We will not move to a mark-up in the immediate future. We will have to give further thought and consideration to the testimony given, perhaps indeed to have additional hearing on the subject, but I think that we have launched a thought process here into another stage beyond where it has been within the FAA and within the Air Transport Association and among all the others who have given their time and effort and thought to this subject.

[Mr. Chandler's prepared statement appears on page 290.]

Mr. OBERSTAR. And, again, I would like to thank all my colleagues on the committee, those who were here earlier, Mr. Lightfoot, Mr. Clinger, who is ranking member who has given considerable time into the preparation of this hearing, especially Mr. Lightfoot, who has given so much of himself in his genuine deep and passionate concern to save lives.

The subcommittee stands adjourned.

[Whereupon, at 7:12 p.m., the subcommittee was adjourned, to reconvene at the call of the chair.]

PREPARED STATEMENTS OF WITNESSES

ADVANCE COPY

BEFORE THE HOUSE SUBCOMMITTEE ON AVIATION

MANDATORY CHILD RESTRAINTS: THE FLIGHT ATTENDANT VIEW

JULY 12, 1990

SUSAN BIANCHI-SAND, NATIONAL PRESIDENT
THE ASSOCIATION OF FLIGHT ATTENDANTS, AFL-CIO
ACCOMPANIED BY MATTHEW FINUCANE, AIR SAFETY & HEALTH DIRECTOR

Mr. Chairman, Members of the Subcommittee, thank you for this opportunity to testify on the issue of child restraints aboard aircraft.

The Association of Flight Attendants, AFL-CIO, has long supported the placement of all air travellers in appropriate seat restraint devices, including infants and small children. We therefore commend Congressman Lightfoot for introducing his bill that will ensure that all infants are properly restrained.

One of the great misconceptions about aircraft accidents is the belief that no one is likely to survive them. The truth is that most aircraft accidents occur on take-off and landing and the impact forces are often survivable. Many people can live through an accident if they are properly restrained, suffer minor injuries, and evacuate quickly before the plane is consumed by fire. Our job as flight attendants is to ensure that passengers are properly restrained prior to a crash, and to assist them in immediate evacuation.

We simply cannot do this job when it comes to an unrestrained infant. If a child is placed on a parent's lap, the child may break free from the adult's arms as the plane decelerates and strikes objects on the ground. If the child is placed and held on the floor in front of a bulkhead, the child may also fly about the cabin during the jolting surface movement of the aircraft.

A child that breaks free during a crash faces two serious hazards. First, the child may be injured as she or he strikes the aircraft interior during the crash. Second, the parents may not be able to find the infant after the crash and the child may therefore be killed by the fire. This is what happened in the Sioux City, Iowa crash. The children that were not properly restrained flew about the aircraft, and it was difficult, and in one case impossible, to retrieve the children after impact.

Another serious problem facing unrestrained infants is turbulence. In 1974, an infant on a turbulent flight was strangled when it fell out of a seat and it's neck was caught by a seat belt. At one of our carriers last summer an infant flew out of its mother's arms during severe turbulence and the mother could not find it until she heard crying from underneath a pile of garment bags that had fallen out of a closet. In January of this year, an unrestrained seven week old infant suffered serious head injuries on a DC-10 during turbulence. The child was the only passenger to suffer serious injuries. And just a week ago, two parents on one flight became so nauseated that they needed their air sickness bags and handed their child to a flight attendant. The turbulence was so severe that the flight attendant, who had restrained herself into a seat, lost hold of the baby. The baby flew into the air and out of her sight. A man seated behind the flight attendant picked up the baby.

Members of the Subcommittee, there is absolutely nothing in the Federal Aviation Act that allows the Federal Aviation Administration to provide one level of safety for adults, and another level of safety for children under two.

One has to wonder why the FAA is fighting mandatory infant child restraints, which now has the support of passenger groups, crewmember groups, the National Transportation Safety Board, and the airline industry. We believe that the FAA's position relates to the low priority the agency has historically given to crash survivability in general. We do not have to remind this committee that the FAA has dragged its feet in at least a dozen cabin safety areas, from life vests, to dynamically tested seats for adults, to reduced exposure to toxic fumes in post-crash fires. For several years, the FAA even fought allowing car seats approved by the National Highway Traffic Safety Administration (NHTSA) from coming on board. Given this long history of foot-dragging in the area of crash survivability, it is not surprising that the FAA would oppose mandatory child restraints.

Even though we question the FAA's motive for opposing this safety improvement, it is important to carefully evaluate their arguments. As might be expected, the agency argues that placing infants in restraints is problematic since it is going to cost a great deal of money. Yet all safety improvements cost money. No one is installing TCAS on aircraft for free. Redundant hydraulic systems are not free. Machines that will detect plastic explosives in baggage are not free. Proper crewmember training is not free. Dynamically tested seats that will protect adult passengers are not free. Yet all these safety improvements are needed. We categorically reject using cost as a reason for ignoring potentially life-saving safety improvements.

The FAA has also argued in press statements that the cost to parents of mandatory child restraints may cause parents to switch to automobile travel, which is a less safe form of travel.[1] We have several questions about this argument:

(1) Will carriers charge such high fares for infant seats that parents will turn to automotive travel, thereby causing the carriers to lose the revenue from entire families? If so, why do some carriers now allow properly restrained children under two to fly for free if there is an empty seat on the airplane?

(2) Assuming that the airlines will exploit mandatory child restraints to increase revenues, and assuming that some parents will turn to automobile travel, how much of a safety impact will this change in travel have? After all, we may be talking about a very small percentage increase in total vehicle miles travelled,

---

[1] Although this argument was made by the FAA in the press, it was not made in the FAA's notice of proposed rulemaking. (See FAA quotes in, e.g. Investor's Daily, 2/23/90, and WSJ, 2/22/90).

perhaps nine thousandth of one percent.[2] Moreover, these substitute vehicle miles will probably be driven by a head of a household travelling between major cities with an infant on board (as opposed to a teenager or a drunk driver on a week-end evening).[3] Is the FAA predicting that the number of small children killed in vehicles each year -- about 382 under two years old[4] -- will go up as a result of the possibility of a fraction of a percent increase in automotive travel?[5]

---

[2] In a paper submitted to the FAA by the Competitive Enterprise Institute, economists Richard B. McKenzie and Dwight R. Lee estimate that there would be 185,000,000 additional vehicle miles travelled. The National Safety Council estimates that there are nearly two trillion vehicles miles travelled each year.

[3] McKenzie and Lee estimate that 185,000,000 additional vehicle miles will lead to "just under five additional deaths." To reach that conclusion, the economists must be using the overall fatality rate for all drivers on all types of roads, which is 2.46 fatalities per 100,000,000 vehicle miles. (National Safety Council, Accident Facts, 1989 edition). We are not convinced that families traveling with children on long trips have this fatality rate. An FAA contractor, Apogee Research, apparently concludes that .95 non-infant deaths will result, or one fifth of the McKenzie and Lee estimate. The FAA has only released the Executive Summary of this report, and its assumptions are not known.

[4] McKenzie and Lee state in their paper that 1,200 children under five are killed each year in automobile accidents, citing the National Safety Council. However, 510 of these are pedestrians or pedacylists, while 690 are in vehicles. (NSC, Accident Facts, 1989 ed., p. 55.) In the age group under two years old, there were 459 fatalities, of which about 382 were in vehicles (phone conversation with the National Center for Health Statistics, citing Vital Statistics of the United States). (This compares, for example, with 13,170 fatalities in vehicles in the 15-24 year old age group.)

[5] Although the Executive Summary of the FAA contractor report estimates an annual increase of .95 non-infant automotive deaths, it gives no numerical estimate in the area of increased infant automotive deaths.

(3) If the government really wants, as a matter of safety policy, to promote air travel over car travel, why not put a halt to all proposed air safety improvements, since the increased cost of these improvements might show up in ticket prices and force some individuals to drive instead of fly? Or perhaps we should increase air safety but place a ceiling on all air fares, while creating disincentives for automobile travel, such as increased automobile gasoline taxes. We are not necessarily opposed to moving travellers from cars to planes for safety purposes, but we are curious why the FAA's interest in doing so begins and ends with children under two.

We urge you to press the FAA for answers to these questions. Let us assume, though, for the sake of argument, that it is the government's safety policy to promote air travel over auto travel, that airlines will charge high fares to carry properly restrained children, and that these fares would lead to increased highway travel and ensuing fatalities. If the FAA can convince the Subcommittee of these points, we would urge Congress to consider how it might strongly encourage, or even require, the airlines to place a reasonable ceiling on fares for those using child seats. One step we would like to see would be for the airlines to issue some bold pronouncements on their own concerning low or free fares for children in restraint devices. Surely some airline would like to become known as the "family" airline.

Our job as flight attendants is to make sure that passengers arrive safely at their destination. We are here today to ask the Subcommittee to give us the tools to do that job, including a safe seat for every passenger. The FAA, on the other hand, asks us to look at costs, and inter-modal transportation issues. In our view, transportation safety would best be served if both FAA and NHTSA put cost concerns aside, and each agency tried to ensure the highest possible safety for the transportation mode under its jurisdiction.

STATEMENT OF ANTHONY J. BRODERICK, ASSOCIATE ADMINISTRATOR FOR REGULATION AND CERTIFICATION, FEDERAL AVIATION ADMINISTRATION, BEFORE THE HOUSE COMMITTEE ON PUBLIC WORKS AND TRANSPORTATION, SUBCOMMITTEE ON AVIATION, CONCERNING H.R. 4025. JULY 12, 1990.

Mr. Chairman and Members of the Subcommittee:

I am pleased to have the opportunity to appear before the Subcommittee today to provide the Federal Aviation Administration's views on H.R. 4025, which is currently pending before the Subcommittee.

H.R. 4025 would mandate the use of child safety seats in air transportation. We applaud the safety concerns that underly H.R. 4025 but are opposed to its enactment because mandating the use of child safety seats would lead to more lives lost than saved, and to more disabling injuries than avoided.

At the outset, I want to make clear that the use of approved child safety seats for infants provides a greater level of safety in the event of an airplane crash. Parents should be aware that the use of a child safety seat can increase the likelihood of their child surviving a crash which is otherwise survivable. There should be no debate about that point nor should there be any question about whether the FAA believes that child safety seats should be used. We do. We strongly encourage parents to use approved safety seats for their children.

We cannot support, however, the requirement in H.R. 4025 that the use of child safety seats be made mandatory. Our concern is that, while the chance of survival aboard an airplane may be slightly improved, the costs associated with mandating the carriage of a child in a separate seat will divert a significant number of families from our safest form of transportation--air travel--to the far less safe travel by automobile.

Simply stated, we believe that more people would die each year as the result of the enactment of H.R. 4025 than would be saved by its provisions. This concern has been reinforced by four separate studies which have been performed by outside organizations, and which I shall make available for the record. Let me elaborate.

We believe that passengers would be diverted to automobile travel since it would be extraordinarily expensive for consumers if child safety seat use were mandated. Unlike the costs of TCAS or windshear detection systems or aging aircraft modifications, the costs of mandated safety seats would not be imposed on the airlines to be accepted as a cost of doing business or to be distributed as a modest price increase among passengers generally. Instead, the cost of requiring safety seats would be borne by a select group--the families of infants. One study projects that cost to be an average of $185 per child, amounting to $250 million each year. The 100% use of child safety seats would save approximately 1 life aboard an aircraft over a 10-year period, at a potential cost of $2.5 billion to children's families.

In our view, and in the view of others who have assessed this issue, a significant number of families who would have flown will elect to travel by automobile instead, leading to a greater risk of death not only to the children, who are the intended beneficiaries of H.R. 4025, but to their parents and brothers and sisters who will be in the automobile with them. A December 1987 study by Richard B. McKenzie and John T. Warner entitled "The Impact of Airline Deregulation on Highway Safety," found that the lower costs of airfares resulting from deregulation had improved highway safety by encouraging more people to fly rather than to drive. The converse would appear to be equally true--increased costs can divert passengers from airplanes back to the highways.

Dick Smith, Chairman of the Australian Civil Aeronautics Authority, in a June 6, 1989, article--"You'll live longer in the air"--which was published in the Australian business periodical, The Bulletin, says: "the figures show that all forms of paid air travel are safer than travelling by car--varying from about twice as safe if you have chartered a small plane, to five times as safe in a small commuter aircraft, to 400 times safer with the airlines. . . . After a study of the safety comparisons between air and road, it is fair to ask why there seems to be so little concern about road safety."

A study performed by Apogee Research, Inc., in behalf of the FAA finds that "the required use of child safety seats will decrease the expected number of infant fatalities in air transportation, but increase the expected number of infant and non-infant family member fatalities as some families switch to automobiles for travel." The study also concludes that, in the first year of implementation of mandated safety seats, the deaths of those who would be diverted to automobiles would be 20 times greater than the potential lives saved aboard aircraft through safety seat use. ("An Impact Analysis of Requiring Child Safety Seats in Air Transportation," Apogee Research, Inc., June 4, 1990.)

Richard B. McKenzie (professor of economics and finance at the University of Mississippi) and Dwight R. Lee (professor of economics at the University of Georgia), who serve as adjunct fellows at the Center for the Study of American Business at Washington University in St. Louis, also researched the effect of mandating the use of child safety seats. ("Ending the Free Airplane Rides of Infants: A Myopic Method of Saving Lives", 1990.)

Professors McKenzie and Lee observe that those who support a rule change requiring the use of child safety seats "are understandably concerned about the safety of traveling children." They go on to note, however, that such a mandatory requirement, if adopted,

> "could have precisely the opposite effect of the one intended: The rule change could increase the travel injuries and deaths of infants and toddlers--and their parents and siblings. These perverse results would likely occur because the rule change would drive up the cost of travel by air and drive many families back to the nation's highways. And car travel remains far more dangerous, at least 30 times more so in terms of death-rate per mile traveled for all travelers--parents and children alike--than air travel by all scheduled (large and commuter) airlines."

Using what they believe to be "reasonably conservative" assumptions, Professors McKenzie and Lee find that the shift to automobile travel caused by higher fares to families of children "could translate into more than 1,600 additional automotive accidents each year, and the increase in accidents could result in more than 175 additional disabling injuries and just under five additional deaths each year. . . . If the fare increase is much greater than the FAA conservatively assumes, the increase in highway injuries and deaths would, of course, be greater."

They further point out that "[a]n unknown number of the victims will surely be infants who would have traveled quite safely on their parents' laps in airplanes. However, many of the automotive victims will be the infants' parents, brothers, and sisters, but many will also be travelers who had never contemplated air travel as an alternative means of transportation. They just happened to be at the wrong time on the nation's roads, made marginally more congested by the infant-seat requirement."

Professors McKenzie and Lee conclude in their research paper that as a consequence of requiring child safety seats "the resulting increase in automotive deaths, although quite small, could easily be several times--quite possibly more than 35 times--the reduction in airline deaths. Congress and the FAA should not be in the business of creating a travel-safety problem that is bigger than the one being solved."

Professors Robert J. Windle and Martin E. Dresner of the College of Business and Management of the University of Maryland also examined the issue of requiring child safety seats in an April 1990 paper entitled "Mandatory Child Safety Seats in Air Transport: Do They Save Lives?"

Their model considered a variety of possibilities, ranging from different percentages of passengers who would be diverted to automobile travel to varying trip lengths on the road. Using the average auto fatality rate, under virtually every scenario, more lives would be lost by mandating child safety seats.

Only with the most conservative assumptions--only 10% of passengers would be diverted to automobiles; automobile trip lengths replacing airplane travel would average only 77 miles--did the lives lost due to diversion not exceed the lives that would be saved on airplanes. Even in this case, the researchers cautioned against mandating child safety seats, observing that

> "it would be better to not change the regulatory system from an injury point of view. Using data from the Statistical Abstract of the United States (United States, Department of Commerce, 1989, p. 590), it is clear that whereas in air transportation the injury rate is only one-half the death rate, in automobile transportation, the injury rate is 39 times the death rate. From an injury point of view, air transport has an even greater safety advantage over auto transport, than from a fatality viewpoint."

Professors Windle and Dresner note that

> "[t]he conclusions from this analysis are clear - mandating the use of child safety seats will result in an INCREASE in fatalities, given the assumptions of the paper, and given almost all of the scenarios discussed. Air passengers will be diverted to auto travel, and given

> auto travel's poorer safety record, more travellers will die in fatal accidents. Even when it is assumed that tickets for children under 2 will be given away for free, enough traffic will be diverted from the airways to the highways to increase the fatalities total. Only under unrealistically favorable assumptions - all travel on interstate highways, very low diversion rates and very low trip lengths - will the safety seats even come close to saving as many lives in the air as they cost in lives to diverted auto traffic."

In closing, Mr. Chairman, I would like to reemphasize that parents who travel on aircraft with small children should use an approved safety seat for their children. There is no question but that the use of a safety seat will improve their child's chance of surviving an accident. Despite the safety benefit associated with use of a child safety seat, however, we cannot in good conscience support legislation that would mandate the use of child safety seats in view of the research which demonstrates that to do so would result in greater numbers of travelers' deaths. Although the studies differ in terms of numbers of fatalities to be expected, based on different assumptions they have used, all project that there would be additional deaths from requiring safety seats.

As the Subcommittee knows, we are currently involved in a rulemaking process that has sought public comment on alternative approaches to this issue, and we are giving it a high priority.

That completes my prepared statement, Mr. Chairman. I would be pleased to respond to questions you may have at this time.

USE OF CHILD RESTRAINTS IN AIRCRAFT

Studies That Are Being Considered by the FAA in Making a Decision

1. Richard B. McKenzie and Dwight R. Lee, Ending the Free Ride of Children on Airplanes: A Myopic Method of Saving Infants' Lives
   Submitted to FAA Docket No. 26142 by the Competitive Enterprise Institute

2. Richard B. McKenzie and John T. Warner, The Impact of Airline Deregulation on Highway Safety
   Submitted to FAA Docket No. 26142 by the Competitive Enterprise Institute

3. Robert J. Windle and Martin E. Dresner, College of Business and Management, University of Maryland, Mandatory Child Safety Seats in Air Transport: Do They Save Lives?
   Submitted to FAA Docket No. 26142 by Drs. Windle and Dresner

4. Apogee Research, Inc., An Impact Analysis of Requiring Child Safety Seats in Air Transportation, Draft, June 4, 1990
   Study conducted for the FAA under contract

ENDING THE FREE AIRPLANE RIDES OF INFANTS: A MYOPIC METHOD OF SAVING LIVES

Richard B. McKenzie
Dwight R. Lee[1]

Since 1978, airline deregulation has resulted in substantial benefits going to the traveling public. Travelers can fly more places more frequently at significantly lower cost.[2] Econometric research reveals that after adjusting for many factors that affect the airline business and in spite of the run-up in air fares in 1988, average ticket prices since deregulation were on average 18 percent lower than they would have been if the Civil Aviation Administration had continued to set fares in the 1980s.[3] All in all, the traveling public has saved tens of billions of dollars in getting to their destinations.[4]

---

[1] Mr. McKenzie is Hearin/Hess professor of economics and finance at the University of Mississippi, and Mr. Lee is Ramsey professor of economics at the University of Georgia. Mr. McKenzie is an adjunct fellow at the Cato Institute. An earlier version of these comments was filed with the Federal Aviation Administration with reference to Docket No. 26142 by the Competitive Enterprise Institution in Washington, D.C. (May 30, 1990).

[2] One of the most complete early studies of the economic benefits of airline deregulation was done by Steven A. Morrison and Clifford Winston, The Economic Effects of Airline Deregulation (Washington: Brookings Institution, 1986).

[3] Steven A. Morrison and Clifford Winston, "The Dynamics of Airline Pricing and Competition," American Economic Review (May 1990), p. 390.

[4] Morrison and Winston estimate that deregulation saved airline travelers $6 billion (in 1988 dollars) a year between 1979 and 1989 (Ibid.).

Furthermore, studies demonstrate that the skies have not been made less safe by deregulation.[5] The estimated 22 percent reduction in airline insurance rates directly attributable to deregulation indicate that private insurance companies believe the skies are safer than they would have been if the government had continued to regulate the industry.[6]

Nevertheless, a movement is afoot within the airline industry and Congress to nullify, in the name of safety, many of these benefits by ending the free ride of infants and toddlers. The airline industry's support of the proposed regulation is understandable, although objectionable. If adopted, the new regulation would enable airlines to suppress important competitive forces and to sell millions of seats each year that current market conditions will not permit.

However, the traveling public should object to the proposed rule not only because it would raise traveling costs but also because it would actually increase the death rate of traveling infants and toddlers and their parents.

THE PROPOSED RULE

Currently, parents can buy airline tickets for themselves and hold their infants and toddlers under two years of age on their laps during flights. Under the banner of saving children's lives in air accidents, the National Transportation Safety Board (NTSB) and the Los Angeles Area Child Passenger

---

[5] See Richard B. McKenzie and William F. Shughart, "Has Deregulation of Airlines Caused More Air Fatalities?" Regulation (Number 3/4, 1988), pp. 42-47; and Nancy L. Rose, "Financial Influences on Airline Safety," working paper no. 1890-87 (Cambridge, Mass.: Sloan School of Management, M.I.T., 1987).

[6] Steven A. Morrison and Clifford Winston, "Air Safety, Deregulation, and Public Policy," Brookings Review (Winter 1988), p. 14.

Safety Association has petitioned the Federal Aviation Administration (FAA) to end the free ride of infants by requiring the use of child-restraint systems in paid seats.[7] James Kolstad, chairman of the NTSB, maintains that "the economic cost of the extra passenger seat and the restraining device it would occupy are a very small price for preventing injuries and saving lives."[8]

In case the FAA resists changing its seating rules, Representative Jim Lightfoot (R-Iowa) and Senator Kit Bond (R-Missouri) have introduced legislation to mandate the use of safety seats by the 5,000 to 10,000 infants and toddlers who fly daily on the nation's 16,000 flights.[9] Congressmen Lightfoot was spurred to introduce his bill by the death of an infant in the crash of United Airline flight 232 in Sioux City, Iowa last July. He reasons that rules requiring the use of safety seats in automobiles should be extended to airlines because "the potential for injury in an aircraft flying at 550 miles per hour is much greater than the potential for injury in an automobile traveling at 50 miles per hour."[10]

Representative Lightfoot maintains that his proposal does not mandate the purchase of additional seats, only the use of safety seats by infants. He reasons that parents can use their safety seats required for automobiles, which have also been approved for air travel, and can continue to use empty airline seats free of charge, as they now do. However, the safety seat rule would have the effect of requiring parents to buy additional airline seats for their infants and to rent child-restraint systems, if they do not have one of their own available. Very few parents would buy their own tickets -- especially the cheaper advanced tickets that are not refundable -- and take the risk of not being able to board at the last minute because adjoining seats are unavailable.

---

[7] Federal Aviation Administration, U.S. Department of Transportation, Miscellaneous Operation Amendments, Federal Register (March 1, 1990), pp. 7414-7421.

[8] James L. Kolstad, "Require Safety Seats for Little Travelers," USA Today (May 24, 1989), p. 12A.

[9] See House, U.S. Congress, 101st Cong., 2d Sess., A Bill to Amend the Federal Aviation Act of 1958 to Require the Use of Child Safety Restraint Systems Approved by the Secretary of Transportation on Commercial Aircraft (H.R. 4025).

[10] Jim Lightfoot, "The Need for Child Safety Restraints aboard Aircraft," Congressional Record (February 27, 1990).

THE EFFECTS OF MANDATED AIRLINE SAFETY ON HIGHWAY TRAVEL

The FAA, the National Transportation Safety Board, the 50 or so members of Congress, and everyone else who support the rule change are understandably concerned about the safety of traveling children. If the extra cost of infant safety seats were the only factor worthy of consideration, the infant seat regulation would probably not necessitate, as NTSB Chairman Kolstad fears will be the case, "countless hours of debate or thousands of pages of testimony before changes occur."[11] However, what child-safety advocates and the FAA have not yet considered is that the proposal, if adopted, could have precisely the opposite effect of the one intended: The rule change could increase the travel injuries and deaths of infants and toddlers -- and their parents and siblings. These perverse results would likely occur because the rule change would drive up the cost of travel by air and drive many families back to the nation's highways. And car travel remains far more dangerous, at least 30 times more so in terms of death-rate per mile traveled, for all travelers --

---

[11] Kolstad, "Require Safety Seats for Little Travelers."

parents and children alike -- than air travel by all scheduled (large and commuter) airlines.

In a study that has not yet been released, FAA researchers concluded that mandatory infant safety seats could have prevented at most only two infant deaths over the past 14 years. All other infant fatalities in airline crashes occurred in sections of planes where no one survived.[12] On the other hand, nearly 1,200 children under five years of age were killed in automobile accidents in 1988.[13] That means that there were approximately one-quarter more automotive deaths of very young children in 1988 alone than there were total deaths of children and adults on scheduled airlines over the entire

---

[12] As reported by Harry F. Waters and Clara Bingham, "How Do Planes Differ from Buses," Newsweek (June 4, 1990), p. 70. In a Harvard Medical School study Richard Snyder estimates that the infant-seat requirement would save an average of only .6 infant lives a year, or three lives over the five years [Richard G. Snyder, "The Status of Infant/Child Restraint Protection in Crash Impacts," a paper presented at the FAA/Flight Safety Foundation International Aircraft Occupant Safety Conference and Workshop, October 31-November 3, 1988), as reported in Walter S. Coleman, "ATA Petition: Infant/Child Restraints" (Rules Docket, AGC-204), filed with the Federal Aviation Administration (February 22, 1990), p. 4]. The FAA found that an additional 6 infants and toddlers were injured in airline flights over the past 14 years [as reported in "Don't Require Seats for Tots Who Fly," USA Today (May 24, 1990; editorial), p. 12A].

[13] Accident Facts: 1988 (Chicago: National Safety Council, 1988). In addition, it should be noted that the infant death rate, which can be inferred from FAA findings, was slightly less that 2 per 100,000 daily boardings of infants for the past 14 years (the mean of the estimated range of daily boardings, 5,000 to 10,000, or 7,500, times 14). The death rate for infants under one in 1984 was 5 due to mechanical suffocation, 4.2 due to ingestion of food and objects, 3.8 due to fires and burns, 4 due to drownings, and 1.9 due to drownings [Accident Facts: 1988, p. 8].

1980-1988 period.[14]

According to the FAA's own (admittedly rough) calculations, mandated seats for infants could increase the average air-travel cost of a family of four (two parents with one child over three and one infant) by at least 21 percent -- assuming that airlines charge only half fares for infants and do not raise their fares across the board because of increased demand. That assumed cost increase could reduce the boardings of infants by about 18 percent, or 700,000, again according to FAA estimates. Nevertheless, the FAA figures that airlines would be able to sell 3.3 million seats each year to infants' parents at a cost of $205 million, a handsome sum that goes a long way toward revealing the airlines' economic interest in the proposed rule.

Of course, many of the families who could no longer afford air travel can be expected to complete many, but not all, of their travel plans by car. This observation should cause Washington policymakers to pause in their deliberations.

DEATHS ON THE NATION'S HIGHWAYS: THE POLICY TRADE-OFF

Studies have not yet been done on the precise effects of the proposed child-seat rule for airlines on the additional automobile travel and attendant accidents, deaths, and injuries of children and their parents. However, the rule-making process may not wait for such studies to be completed.

---

[14] Total airline fatalities on scheduled airlines (U.S. air carriers operating under 14 CFR 121) between 1980 and 1988 was 975, and that figure includes the 259 passengers killed in the explosion of the Pan American flight over Lockerbie, Scotland [U.S. Department of Transportation, Federal aviation administration, FAA Statistical Handbook of Aviation: 1988 (Washington: U.S. Government Printing Office, 1989), p. 154].

In lieu of the requisite research, it should be noted that our own econometric research (undertaken with colleagues at the University of Mississippi and Clemson University) on the impact of airline deregulation documents a point that the FAA and Congress must keep in mind: Air and highway travel are interchangeable, and changes in airline fares significantly alter the amount of highway traffic.[15] And highway accidents, injuries, and deaths are highly correlated with the amount of highway travel and congestion.

Indeed, we found that airline deregulation, which led to lower air fares and an expansion of flights, increased air travel by an annual average of 11 percent and reduced passenger car travel by an annual average of just under 4 percent between 1978 and 1985. Accordingly, airline deregulation significantly reduced highway accidents, injuries, and deaths.[16]

Our research suggests that there is every reason to believe that the proposed air fare increases for families by way of a safety-seat requirement should have the opposite effect. The only unsettled issue is, How much?

If the number of automobile trips by families goes up by a third of the estimated reductions in infant boardings and if the average length of the trips is 400 miles one way (800 miles round-trip), automobile travel will increase by more than 185 million miles each year.[17] That represents a very small percentage increase in automotive travel.

---

[15] McKenzie and Shughart, "Has Deregulation of Airlines Caused More Air Fatalities?" pp. 42-47; and Richard B. McKenzie and John T. Warner, The Impact of Airline Deregulation on Highway Safety (St. Louis: Center for the Study of American Business, Washington University, December 1987).

[16] McKenzie and Warner estimate that in the 1979-1985 period, after adjusting for a number of factors that affect highway travel safety, airline deregulation reduced automobile accidents by an annual average of over 600,000, lowered automobile injuries by an average of approximately 66,000, and reduced automobile fatalities by an annual average of under 1,700 (McKenzie and Warner, The Impact of Airline Deregulation on Highway Safety).

Nevertheless, using our econometric model, the increase could translate into more than 1,600 additional automotive accidents each year, and the increase in accidents could result in more than 175 additional disabling injuries and just under five additional deaths each year.[18] The additional automobile accidents could also add $6 million to the country's total annual economic losses associated with automobile wrecks on top of the additional air fares that the FAA estimates families will have to pay.[19] If the fare increase is much greater than the FAA conservatively assumes, the increase in highway injuries and deaths would, of course, be greater.[20]

---

[17] We think our assumptions are reasonably conservative because the average length of one-way trips of airline passengers in 1987 was 780 miles, almost equal to what we assume the additional round-trips by cars will average.

[18] One important caveat should be kept in mind in interpreting our estimates of automobile accidents, damage, injuries, and deaths. They are based on "average" driver characteristics, and the would-be airline passenger who switch to highway travel may not mirror the characteristics of the average driver. At this point in our research, we cannot be sure whether the additional automobile travelers would, on average, be more or less safe drivers than other travelers. While traveling families may on average be safer drivers than other highway travelers, we do not know how the families that switch from air to highway travel, who may on average have lower incomes and lighter and older cars, compare with travelers in general.

[19] These additional automotive costs, which are computed based on National Safety Council estimates (Accident Facts: 1988), include lost wages, medical expenses, and property damage. They do not include the costs incurred by government agencies, for example, fire departments and court systems, that will have to cope with the consequences of the additional accidents.

[20] We consider our assumptions reasonably conservative because we do not make allowance for the effect that the increased demand for seats would have on the fares of all other passengers.

An unknown number of the victims will surely be infants who would have traveled quite safely on their parents' laps in airplanes. However, many of the automotive victims will be the infants' parents, brothers, and sisters, but many will also be travelers who had never contemplated air travel as an alternative means of transportation. They just happened to be at the wrong time on the nation's roads, made marginally more congested by the infant-seat requirement.[21]

CONCLUDING COMMENTS

Admittedly, our calculations are rough. The point of this briefing is that in the name of child safety, advocates of the FAA rule change should consider the prospect that while their hearts may be in the right place, their proposal may be misguided. At the very least, the FAA, Representative Lightfoot, and Senator Bond should ask that more precise statistical estimates be done before blindly adopting a mandate that sounds good -- on the surface.

The proposed rule change might reduce very slightly the number of air injuries and deaths. However, the improvement in air safety is likely to be extraordinarily small because there are so few infants who are air victims, because the safety seats will not be close to 100 percent effective, and because many parents will continue to hold their infants and toddlers in their laps, especially at times when the infants and toddlers need to be fed or would otherwise disturb surrounding passengers.[22]

---

[21] Our econometric model relates marginal changes in the number of miles traveled by car to highway accidents, injuries, and deaths. It does not permit to say exactly how many of the automotive victims would have flown, just it does not enable us to specify how many of the victims will be infants and toddlers.

As a consequence, the resulting increase in automotive deaths, although quite small, could easily be several times -- quite possibly more than 35 times -- the reduction in airline deaths.[23] Congress and the FAA should not be in the business of creating a travel-safety problem that is bigger than the one being solved.

FN=INFANT062990 9D

---

[22] Advocates are concerned that children held on their parents laps can be thrown to the floor or ceiling in air turbulence. It would appear that such a problem could easily be solved by parents using some form of inexpensive restraining harness that are in wide use.

[23] Assuming that the safety seats will save two infant lives over 14 years (which is the FAA's estimate of what would have been the result for the past 14 years) and that the increased driving due to higher air fares will result in an average of five additional highway deaths each year (which is our estimate of the likely affect), the mandated infant seats will result in 35 times more deaths on the nation's highways than will be saved in air crashes.

THE IMPACT OF AIRLINE DEREGULATION ON HIGHWAY SAFETY

by

Richard B. McKenzie
and
John T. Warner

OP 68

December 1987

CSAB
WASHINGTON UNIVERSITY CAMPUS BOX 1208 ONE BROOKINGS DRIVE ST. LOUIS, MISSOURI 63130-4899
CENTER FOR THE STUDY
OF AMERICAN BUSINESS

HIGHLIGHTS

Has airline deregulation resulted in more travel risks and deaths? To date, researchers have tried to address that question by assessing the impact of airline deregulation in 1978 on subsequent air accidents and deaths.[1]

However, by affecting how people travel, airline deregulation has very likely also affected travel on the nation's highways. Through its effects on the level and composition of ground travel, the deregulation of air travel may have reduced total travel deaths in the United States. This is likely to be the case because the fatality rate for travel by roads is marked higher than travel by air.

The primary purpose of this study is to present an estimate of the number of lives saved from reduced ground travel attributable to airline deregulation. Specifically, our research leads to two important observations relevant to the public policy debate over airline regulation:

First, after 1978 there was a marked "structural" decrease in the growth of ground travel that was unrelated to changes in a range of factors

---

Richard McKenzie is professor of economics at Clemson University and an adjunct fellow at the Center for the Study of American Business at Washington University in St. Louis. John Warner is also a professor of economics at Clemson University. The authors are indebted to Kenneth Chilton, Arthur Denzau, Hugh Macaulay, William Shughart, Murray Weidenbaum, Clinton Whitehurst, and Bruce Yandle for helpful comments on earlier drafts They also wish to thank Melissa Ellenberg, Jody Lipford, Susan McKenzie, and Curtis Middleton, for helpful research assistance.

---

[1] See Richard B. McKenzie and William F. Shughart II, Deregulation's Impact on Air Safety: Separating Fact from Fiction, OP 65 (St. Louis: Center for the Study of American Business, Washington University, September 1987), condensed and reprinted in Regulation (November/December 1987). See also Thomas Gale Moore, "Deregulation and Safety" (Washington: Council on Economic Advisors, Executive Offices of the President, 1987); and Nancy L. Rose, "Financial Influences on Airline Safety," Working Paper No. 1890-87 (Cambridge, Mass.: Sloan School of Management, M.I.T., 1987).

that normally affect driving, including changes in the relative cost of ground travel, income, population, distribution of driving between rural and urban areas, and permissable speed of highway driving. Between 1979 and 1985, passenger-car travel appears to have been, on average each year, 3.9 percent (or about 46 billion miles) lower than the amount of driving that would have been predicted from driving patterns established in the 13 years prior to 1979. Our research convinces us that deregulation played a major role in lowering the growth in automotive travel.[2]

Second, if all of the lower passenger-car miles are directly or indirectly attributable to airline deregulation, the number of accidents avoided is very large, exceeding 660,000 a year for the 1979-1985 period. The number of lives saved is equally dramatic, perhaps ranging up to an average of almost 1,700 each year. The reduction in economic losses from automotive accidents is approximately $1.9 billion a year. Even if the decrease in car travel has only half the impact of our estimate, 300,000 fewer accidents and 800 fewer deaths are substantial figures.[3]

Our findings are instructive for one main reason. They indicate that any attempt to resurrect the type of airline regulation that was abandoned in the late 1970s may well lead to higher deaths from ground travel.[4]

---

[2] Indeed, it is difficult for us to imagine any other change in the economy that would have significantly changed driving patterns as much as airline deregulation.

[3] In seeking to assess the impact of safety improvements on automotive deaths, economists at the Brookings Institution found that, after adjusting for improvements in the "average crashworthiness" of automobiles and the decline in the average weight of automobiles during the 1947-1981 period, a 1 percent increase in miles of automotive travel increases highway deaths by approximately .431 percent. This adjusted figure is nearly equal to half of our estimated impact (our model predicts an .895 percent increase in highway deaths due a 1 percent increase in auto travel). [Robert W. Crandall, Howard K. Gruenspect, Theodore E. Keeler, and Lester B. Lave, Regulating the Automobile (Washington: Brookings Institution, 1986), p. 63].

These findings are summarized in Table 1 and discussed in the body of the study. The econometric analysis on which the conclusions are founded is presented in the appendix.

AIRLINE DEREGULATION: BACKGROUND AND CONSEQUENCES FOR GROUND TRAVEL

Policymakers are understandably concerned that the deregulation of the nation's airlines initiated by Congress in 1978 may have reduced air safety and slowed the long-run decline in air deaths. With the gradual contraction of authority at the Civil Aeronautics Board (CAB) after 1978 and its eventual demise in 1985, deregulation has meant that airlines have acquired progressively greater freedom to enter markets, restructure routes, and set fares -- in general, to compete openly with fewer government controls over how market demand for air travel will be met.[5]

The greater competition among airlines may have led to greater congestion in the nation's airways and more opportunities for accidents. Deregulation could also have led to a greater number of airlines hiring more pilots with less flying experience, and to the substitution of price

---

[4] Airline deregulation does not appear to have increased fatalities from air travel [McKenzie and Shughart, Deregulation's Impact on Air Safety]. In addition, our findings suggest that air and ground travel are sensitive to their relative prices. As a consequence, efforts to improve the safety of airlines may (unless done carefully) be counterproductive. Such efforts can raise the prices of air travel relative to ground travel and can cause travelers to return to the highways, increasing highway accidents, fatalities, injuries, and economic losses.

[5] Deregulation started in 1979 with airlines being given limited flexibility to add routes and take over unused routes. Airlines were not given the flexibility to adjust prices and routes freely until 1983.

Table 1. Average Annual Estimates of Highway Safety Improvements Attributable to Airline Deregulation, 1979-1985

Reduced automotive deaths	1,700
Reduced automotive accidents	665,000
Reduced injuries	66,000
Reduced cost	$1.9 billion

Source: Author's calculations, based on regression equations reported in the appendix.

competition for safety competition in the airline industry. Media attention given to air crashes in recent years may appear to validate such fears and to justify calls for the reregulation of the airlines.[6]

Nonetheless, the available empirical studies of the effect of deregulation on air deaths do not support claims that air safety, as measured by airline deaths and accidents, has been compromised since deregulation.[7] Still, proponents may argue that reregulation with greater attention to safety should be adopted on the grounds that it may speed the long-run decline in air accidents and deaths. Such arguments may be tendered, as they have been, with little concern for the impact of reregulation on the relative price and volume of air travel vis-a-vis other modes of travel.

The policy debate over airline reregulation has so far overlooked the important economic linkages between air travel and ground travel. Consumers can be expected to adjust marginally their travel modes among airlines, cars, and buses, depending upon the relative prices, quality of service, and availability. Reregulation can be expected to affect all three -- price, service, and availability -- just as deregulation has affected all three.[8]

---

[6] Hobart Rowen, "Bring Back Regulation," Washington Post Weekly, August 31, 1987, p. 5.

[7] See McKenzie and Shughart, Deregulation's Impact on Air Safety; Moore, "Deregulation and Safety"; and Rose, "Financial Influences on Airline Safety." Deregulation does appear to have led to more passenger-miles flown and, hence, to more reported "near misses." However, the historical connection between number of passenger-miles flown and near misses has not been changed by the advent of deregulation. The rapid growth in the reported count of near-misses between 1982 and 1986 was due to several factors, not the least of which are improvements in the reporting system and growth in the economy (and thereby miles flown). These points are developed in McKenzie and Shughart, Deregulation's Impact on Air Safety.

Concern for the effects of airline regulation on alternative modes of travel is hardly a matter of academic interest alone. If automotive deaths are related to miles traveled and if airline deregulation has caused a net substitution of air for ground travel, then airline deregulation could be responsible for a net reduction in travel accidents and deaths.[9] This is especially true since an increase in air deaths has not been observed and the death rate per vehicle-mile traveled on the nation's roads is substantially greater (perhaps as much as 100 times greater) than the death rate per passenger-mile traveled in the air.[10] Similarly, reregulation of airlines could cause a reverse substitution -- ground for air travel -- leading to more ground-travel deaths with or without a reduction in air deaths.

Airline deregulation has increased passenger-miles flown. According to one estimate, the increase in flying attributable to deregulat averaged, between 1979 and 1986, more than 11 percent a year for domestic airlines flying in the domestic market.[11] What is not known is the extent to which greater air travel has, on balance, altered ground travel. Although it may be reasonable to suspect that ground travel has declined, there exists no strong a priori, theoretical reason for believing that airline deregulation has, on balance, reduced ground travel.

---

[8] See Moore, "Deregulation and Safety."

[9] The scholarly research designed to test the impact of government regulation of automobile safety does indeed support the commonly held expectation that, after adjusting for a number of variables that affect automobile design, miles of ground travel is positively and significantly related to the number of automotive deaths. See Crandall, et al., Regulating the Automobile, chap. 4.

[10] During the first half of the 1980s, the air death rate per billion passenger-miles was approximately .3, while the highway death rate per billion vehicle-mile was approximately 37. Note the comparison is drawn between the death rates for vehicle-miles on the ground and passenger-miles in the air. Since vehicles often have more than one occupant, each vehicle-mile actually represents more than one passenger-mile of travel. Thus, the risk of death per mile per auto passenger is probably less than 100 times that of air travel. However, the necessary counts of passenger-miles on the ground are not available for strict comparisons of death rates.

Airline deregulation has probably had a mixed impact on the volume of ground travel. On the one hand, because of lower fares and more flights since deregulation, many travelers may have parked their cars in favor of planes for long- and even short-distance flights. On the other hand, deregulation sets in motion economic forces that may have marginally increased ground travel.

First, many of the additional air-miles induced by deregulation may have been flown by travelers who would not otherwise have taken as many trips. The additional air travel may have given rise to more ground travel (to and from airports, if nothing else).

Second, greater efficiency in the airline industry due to deregulation may have marginally increased national income and, therefore, may have led to a greater demand for ground travel (as well as air travel).

Third, deregulation may have reduced air service to small rural airports (where service was required by the CAB), causing many travelers who would have flown to drive farther to airports or to switch altogether from planes to cars for some trips.

The impact of airline deregulation on ground travel is made more complex by the fact that planes, in general, fly a more direct path than cars are driven. Hence, any net increase in miles flown could be accompanied by an even greater net reduction in miles driven.

---

[11] McKenzie and Shughart, Deregulation's Impact on Air Safety, pp. 16-19.

Even if airline deregulation has reduced the total number of miles driven, it does not follow, necessarily, that automotive deaths have fallen. This is the case because airline deregulation may have significantly redistributed the total number of miles driven between urban and rural streets and highways. Because death rates differ for rural and urban driving, the recomposition (if any) of miles-driven due to deregulation can affect total automotive deaths.

The central task of this study is to answer empirically two questions: First, independent of all other forces affecting travel, how has airline deregulation affected total passenger-car miles driven? Second, if ground travel has been affected by airline deregulation, what is the empirical relationship between volume of ground travel and automotive accidents, deaths, and economic losses from automotive accidents?

THE IMPACT OF AIRLINE DEREGULATION ON GROUND TRAVEL

Ground travel is, of course, influenced by many factors other than the extent of airline regulation. Several of the more important determinants of the volume of ground travel include the relative cost of ground transportation (including the price of gasoline and the cost and maintenance of cars), disposable income, population, and permissible driving speed.

Vehicle-miles traveled can be expected to be negatively related to the relative price of ground transportation. The quadrupling of gasoline prices in the 1970s, for instance, likely reduced vehicle-miles, while the reduction in gasoline prices in the 1980s probably stimulated miles driven.

Vehicle-miles could be expected to be directly related to disposable income: higher income, higher vehicle-miles. The gradual increase in the country's population over time has very likely increased the demand for travel of all kinds. The permissible speed on the roads affects the time-cost of travel. Because it increased the cost of ground travel, the decrease in the speed limit for interstate highways in the mid-1970s probably reduced the willingness of people to use their automobiles.

The problem of assessing the impact of airline deregulation on ground travel is statistical, one of separating the individual effects of these variables, including airline deregulation, from each other. This section of the study describes in general terms the estimated separate influence of deregulation on various categories of ground travel. (The econometric techniques employed to obtain these and other results are summarized and discussed in the appendix, Table A-1 through Table A-4.)

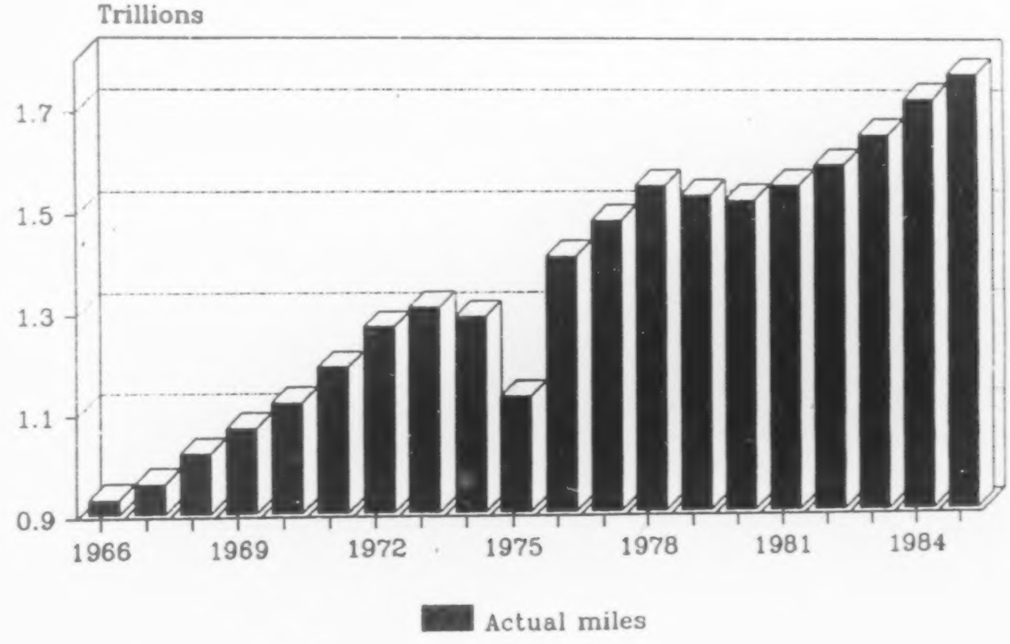
Vehicle-Miles

The history of miles driven by all types of vehicles (cars, buses, motorcycles, trucks, etc.) is portrayed by the bars in Figure 1. The trend is decidedly upward, from .9 trillion vehicle miles in 1966 to nearly 1.8 trillion vehicle miles in 1985.[12] However, as evident in the figure, growth in the total number of vehicle miles began to slow slightly in the

---

[12] Federal Highway Administration, U.S. Department of Transportation, Highway Statistics: Summary to 1985 (Washington: U.S. Government Printing Office, n.d.), pp. 227-228.

Figure 1. Total Vehicle Miles
1966–1985



Source: Federal Highway Administration

late 1970s, partially due to increases in energy prices and to reductions in the growth in real national income in the late 1970s and early 1980s.

Passenger-car miles account for approximately 70 percent of total vehicle-miles. For our purposes, it is the impact of airline deregulation on passenger-car miles that is of interest. This effect is evident in Figure 2, which plots all passenger-car miles on all roads (from rural interstate highways to urban streets). The gap between the solid bar series representing actual miles driven and the shaded line graph representing the predicted miles driven (without considering the impact of airline deregulation) gradually widens beyond 1978. (The graph intentionally accentuates this gap by truncating the vertical axis and expanding the scale for the relevant portion of the graph.) The percentage of difference in predicted and actual miles for each year is 3.9 percent, on average.[13]

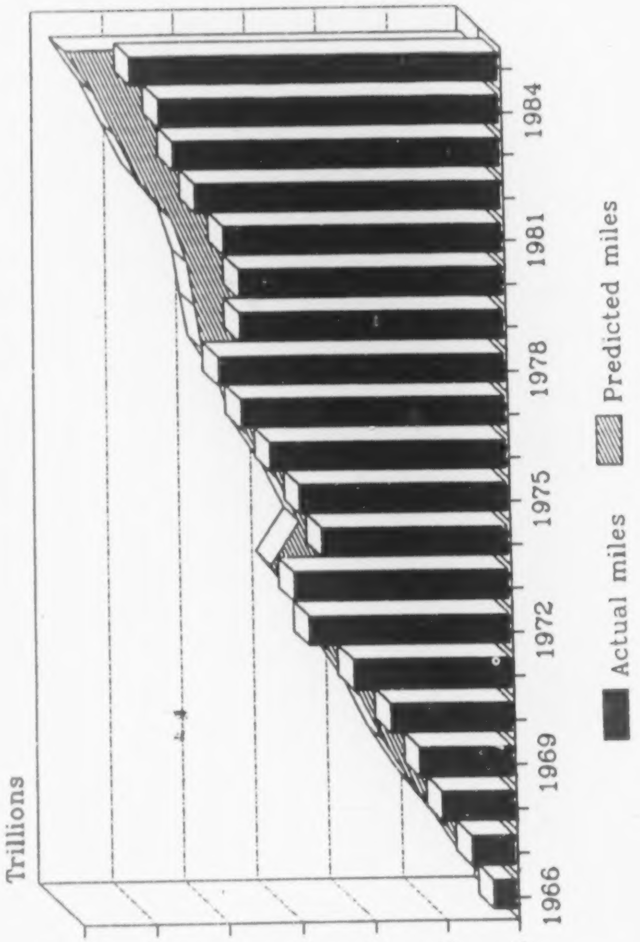
Econometric analysis indicates that the gap between the two series in Figure 2 is statistically significant (not a matter of random chance; see appendix Table A-2, equation 2). That is to say, something caused a divergence between actual and predicted miles driven by automobiles after

---

[13] Our analysis indicates that airline deregulation may have depressed total vehicle miles by an average of 4.5 percent a year between 1979 and 1985 (see Table A-1, equation 2). However, statistical tests indicate that there is a reasonable probability that the observed relationship between total vehicle-miles and the variable (called a dummy variable) used to represent airline deregulation may not reflect the true relationship.

The full negative impact of deregulation on vehicle miles may be partially obscured by the impact of trucking and intercity bus deregulation that occurred during approximately the same period as airline deregulation. The deregulation of trucks and buses could have also led to greater competition among truck companies and bus lines and to more trucks and buses driving more miles at lower prices per ton-mile of cargo. For this reason alone, our analysis must be extended and focused on the impact of airline deregulation on the type of travel most likely affected, namely travel via passenger cars.

Figure 2. Passenger Car Miles
Actual and Predicted, 1966-1985



Source: FHA and authors' calculations

1978.[14] Since the model does a good job of estimating automotive travel, that "something" has to be a factor other than the ones included in the model.[15] We believe the external factor to be the substitution of air travel for automobile travel as a result of lower air fares and increased number of flights due to airline deregulation.[16] Further, we are hard pressed to develop satisfactory alternative explanations for a different external factor that could explain the observed gap.[17]

---

[14] The dummy variable for deregulation in the econometric equation is significant at a confidence level of .01.

[15] The gap between actual and predicted passenger-car miles is statistically significant and virtually the same in a variety of the statistical models tried. When a Spline variable is used to represent airline deregulation, the coefficient is .014 (and statistically significant at a .01 confidence level). This means that airline deregulation was depressing car travel by 1.4 percent more each year. Such an estimate means that by 1985, car travel may have been 9.8 percent less that it would otherwise have been.

[16] Given inherent imprecisions in our statistical methods, we cannot "prove" that the entire gap can be explained by airline deregulation. The gap in Figure 2 amounts to an annual average of 46 billion passenger-car miles, and it is difficult for us to believe that airline deregulation, alone, could have depressed passenger-car travel by that much. Granted, available estimates indicate that domestic air travel increased by about 147 billion passenger miles between 1978 and 1985. However, the impact of airline deregulation, by itself, has been estimated to be responsible for 25 percent of this increase or 38 billion passenger miles (McKenzie and Shughart, Deregulation's Impact on Air Safety). It is possible that the estimated reduction in passenger-car miles could be greater than the estimated average increase in air-passenger miles. As noted, planes can often go between two locations in fewer recorded miles than cars. In addition, the air-passenger estimates do not include any domestic flights by foreign airlines.

[17] The growing gap between actual and predicted passenger-car miles may be explained in part by the deregulation of telephones, by changing living patterns, and the growing cost of automobile regulation. However, we question just how much of an impact these changes could have had. We tried a statistical model including a dummy variable for telephone deregulation, but the impact of the Spline variable used to represent airline deregulation did not change materially, either in terms of statistical significance or magnitude. We also tried a model that included a trend variable (which might capture changes in a number of variables, such as

When the impact of deregulation on car-miles driven on rural (interstate and main arterial) highways is assessed, the same conclusion can be drawn. "Something," very likely including airline deregulation, significantly decreased rural car-miles driven after 1978. The decrease in car-miles driven averaged 3.7 percent per year in the post-deregulation period (Table A-4, equation 2).[18] However, the decline in car-miles driven on urban highways (including interstates) and streets after 1978 was significantly greater on average, 6.4 percent (Table A-3, equation 2).

General Findings

In summary, our research on the determinants of the volume of passenger-car travel supports the view that the number of miles driven is primarily affected by the relative cost of automobile travel, income, population, and speed. In general, higher relative prices tend to suppress driving, whereas a greater population and higher average speed tend to encourage driving -- exactly as anticipated. While a change in per capita disposable income tends to have a positive impact on driving, its effect was not always certain (at least by the standards of precise statistical tests).[19]

---

living patterns, that cannot be easily measured). However, the Spline variable remained close to the upper limit achieved in all other specifications. The growing cost of automobile regulation is captured in our transportation price index.

[18] The coefficient on the Spline variable for deregulation was 1.3 percent and significant at the .01 confidence level.

[19] While we suspect the true effect of income on miles driven may be obscured by the limitations of the data, our results are not totally unexpected. Increases in income definitely affect airline travel, and some of the increase in air travel attributable to higher income may be taken off the roads. To economists, car travel (relative to air travel) may

Our analysis also shows that between 1979 and 1985, airline deregulation appears to have significantly reduced miles driven in passenger cars on America's highways and streets. The percentage of reduced passenger-car miles may be viewed as relatively "small." However, if automotive deaths are directly proportional to passenger-car miles driven, our statistical findings suggest that airline deregulation may have reduced automotive deaths by an annual average of nearly 1,900 (given that automotive deaths averaged approximately 48,600 per year for the 1979-1985 period). In order to develop a more precise estimate of the number of lives saved through airline deregulation, the relationship between deaths and passenger-car miles driven is carefully examined in the following section.

THE IMPACT OF AIRLINE DEREGULATION ON GROUND TRAVEL SAFETY

The central point of the previous section is that airline deregulation has significantly reduced miles of ground travel. The task of this section is to specify the relationship between miles of automobile travel by passenger cars and measures of numbers of accidents, costs, and deaths. With this additional information, we will be able to provide rough estimates of the effect that airline deregulation has had on ground-travel "safety." It appears reasonably clear from our analysis that miles of automobile travel are directly related to our various measures of automotive safety. What remains somewhat uncertain in the statistical

---

be an "inferior good" (which means consumption levels and income levels are inversely related) for many people. For others, air travel may be a perfectly normal good. The uncertain effect of income on net vehicle-miles may reflect the mixed reactions of various drivers.

investigation is the extent to which automotive safety is affected by any given reduction in ground travel.[20] For that reason, we report below the most conservative estimates that we found of safety improvements due to less ground travel.

Automotive Deaths

The ongoing long-run change in automotive safety is most prominently illustrated by the annual number of automotive deaths on all roads. The bars in Figure 3 shows that the actual total automotive deaths rose irregularly from slightly more than 53,000 in 1966 to over 56,000 in 1972, only to fall with equal irregularity thereafter until total deaths were down to under 46,000 in 1985.[21]

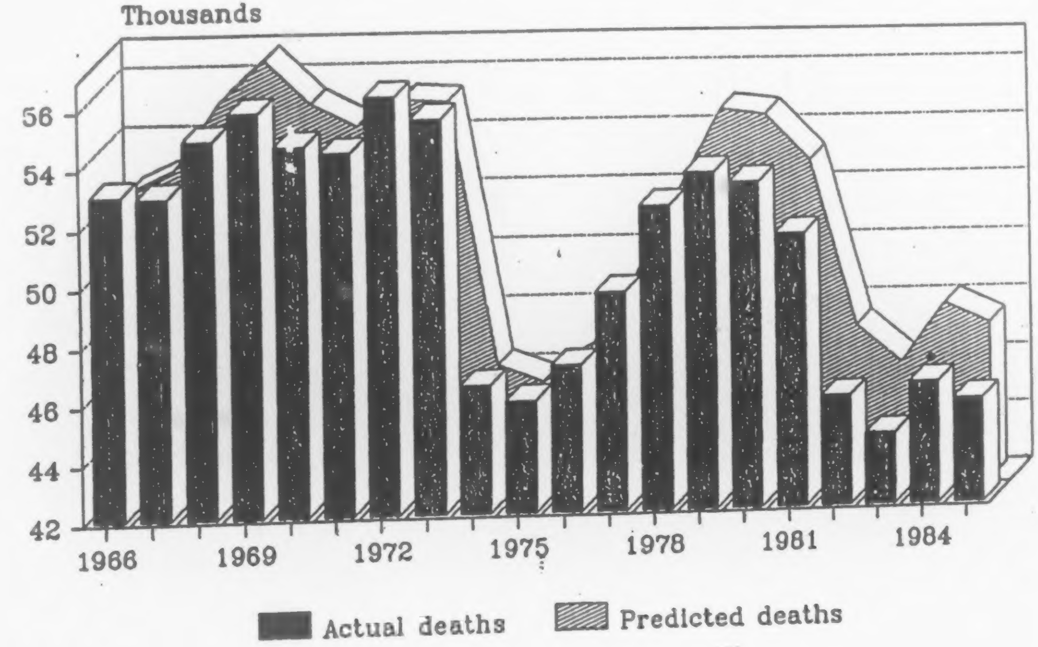
The statistical problem of estimating the importance of airline deregulation in the observed improvement in automotive deaths is made complex by the fact that many factors that influence highway safety are constantly changing. However, we found that consistently more than 60 percent of the variation in automotive deaths could be explained by four principal forces:

---

[20] The reported findings should be read with one important caveat in mind. As may be obvious from careful examination of the statistical results reported in the appendix (in the form of several regression equations), the exact computed impact of miles driven on all measures of automotive safety depends critically upon the way in which the expected explanatory variables are combined in the equations (see Tables A-5 and A-6).

[21] The change in passenger-car deaths was more dramatic than the change in total deaths over the 1966-1985 period. Passenger-car deaths rose from 35,000 in 1966 to 37,100 in 1969 and fell to 23,800 (or by 36 percent) by 1985.

Figure 3. Total Automotive Deaths
Actual and Predicted, 1966–1985



Source: FHA and authors'calculations

(1) vehicle-miles traveled (which generally rose during the period covered by Figure 3),[22]

(2) per capita consumption of alcoholic beverages (which tended to rise until 1973 and fall thereafter),[23]

(3) proportion of drivers who are females (which rose gradually from 41.1 percent in 1966 to 48 percent in 1985), and

(4) proportion of drivers who are teenagers (which rose from 8.8 percent in 1966 to 9.1 in 1974, only to fall back to 6.4 percent in 1985).

The first three factors were generally found to influence deaths to a statistically significant degree. We expected the percent of drivers who are teenagers to also be a significant determinant of deaths, but the relationship was found to be unpredictable.[24] The relative importance of these factors in explaining automotive deaths is evaluated by econometric analysis in the appendix.

The important finding is that during the 1979-1984 period, every 1 percent increase in total passenger-car miles increased total automotive deaths by just under .9 percent (again, using the most conservative estimate of the relationship between percentage change in miles and deaths, see appendix Table A-5, equation 2).[25] This means that the estimated reduction in passenger-car miles (3.9 percent for the 1979-1985 period) may have reduced total automotive deaths by an average of 3.5 percent.

---

[22] Of course, many other highway conditions affect highway safety through their influence on miles driven. To include the indirect effects of changes in transportation prices, income, population, speed, and airline deregulation on automotive safety, we used the econometric work on vehicle-miles, reported in Appendix A, to forecast miles of travel and then used the forecasted miles-driven as a determinant of highway deaths.

[23] Alcoholic consumption includes total purchases of beer, wine, and distilled spirits in real dollar terms.

[24] The variable accounting for changes in the teenage population may not have been a statistically significant influence in part because of the relatively small change in teenage drivers as a percent of all drivers.

These statistics mean that airline deregulation may have "saved" an average of 1,700 lives each year between 1979 and 1985.[26] Put differently, if the airline industry had not been deregulated in 1978, ground travel would have been significantly higher than it actually was and automotive deaths may have been, on average, 1,700 higher each year than they actually were.[27] The predicted number of deaths -- computed by assuming that passenger-car travel continued to follow in the 1980s the pattern established prior to airline deregulation -- is described by the shaded series in the background of Figure 3. Note that the shaded series (predicted deaths) is higher than the bars (actual deaths) after 1978.

We also sought to investigate the possible role of safety improvements in automobiles in reducing automotive deaths. We attempted to adjust our econometric analysis in various ways for design improvements in automobiles by including a safety index, changes in the average age of automobiles on the road, and changes in the size of automobiles (as measured by fuel economy).[28] The impact of these adjustments was, generally, to increase substantially (by as much as 50 percent) the measured impact of the number of passenger-car miles on automotive deaths.[29]

---

[25] The period of analysis is restricted to 1979-1984 because of the absence of data on alcohol consumption for 1985. Estimates of reductions in automotive deaths due to airline deregulation are based on data on automotive deaths reported by the Federal Highway Administration, Highway Statistics: Summary to 1985.

[26] The number of total automotive deaths for 1979-1985 period averaged 48,587.

[27] These findings are supported by additional analysis of the impact of airline deregulation on the deaths of people in passenger cars via a reduction in passenger-car travel (separate from other forms of travel). We estimate that between 1979 and 1985, changes in passenger-car fatalities were virtually proportional to miles driven in passenger cars. This means that airline deregulation, which led to an average 3.9 percent reduction in passenger-car miles, also led to a reduction in passenger-car fatalities by an average of 3.9 percent.

Other researchers have found that after adjusting for several additional variables, including a more complicated safety index in automobiles, a 1 percent reduction in miles traveled reduced deaths by .43 percent in the 1947-1981 period -- or by about half our estimate.[30] Using this estimate of the impact of travel on deaths, we can still deduce that the number of lives saved would be substantial, more than 800 a year.

---

[28] John Graham found that relative to 1965, the "crashworthiness" of automobiles exhibited the following improvements: 4 percent for 1966 and 1967; 19 percent for 1968 and 1969; 24 percent for 1970 and 1971; 28 percent for 1972 and 1973; and 34 percent for 1974 and all following years [John D. Graham, "Automotive Safety: An Investigation of Occupant Protection Policies" (Pittsburgh: Carnegie-Mellon University, Ph.D. dissertation, 1983), tables 3-11]. Our index for design improvements was simply 1 for 1965 and 1 minus the percentage safety improvement for the years 1966 through 1984.

[29] The statistical significance of the coefficient for passenger-car miles was reduced, compared to the unadjusted equations.

[30] Crandall, et al., Regulating the Automobile, p. 63. These Brookings researchers included in their regression equations six variables not represented in our analysis reported in the appendix: safety improvements in automobiles, average weight of automobiles, the OPEC oil embargo, average age of automobiles, percent of travel by trucks, and percent of travel on limited access roads. We did not attempt to replicate completely the work by these researchers. At the same time, our extended analysis did include regression equations that were comparable in terms of the types of variables used. We do not report these extensions in the appendix because the reported estimates of the impact of travel remain more conservative. In addition, we encountered severe problems of multicollinearity. We also worry that the Crandall study does not find a consistent, statistically significant relationship between per capita alcohol consumption and highway deaths. We suspect also that the authors' variable for the OPEC oil embargo (that has a negative sign and runs through 1981) captures some of the negative impact of airline deregulation.

Automotive Accidents

In 1985 there were approximately 19.3 million automotive accidents involving injuries and resulting in property damage to 33 million vehicles.[31] Our analysis indicates that accidents are significantly influenced by passenger-car miles driven.[32] Using our most conservative finding, we estimate that the 3.9 percent fewer passenger-car miles driven in the 1979-1985 period may have reduced automotive accidents by an annual average of approximately 3.6 percent, or by 665,000 (Table A-6, equation 1).

Assuming that the number of vehicles involved in accidents and the number of injuries suffered in accidents are roughly proportional to the number of accidents, the estimated reduction in accidents would have resulted in approximately 66,000 fewer injuries (total disabling and nondisabling injuries).[33] Many, if not most, of these accidents and injuries avoided were, without much question in our view, due to the deregulation of airlines.

---

[31] National Safety Council, Accident Facts: 1986 (Chicago: 1986), p. 40. Estimates of reductions in accidents, injuries, and economic losses are based on data collected from various annual editions of Accident Facts.

[32] Any percentage increase in passenger-car miles has a proportionally greater impact on total automotive accidents than an equal percentage increase in total vehicle-miles. We estimate that a 1 percent increase in total vehicle-miles will increase total automotive accidents by .4 percent, whereas a 1 percent increase in passenger-car miles will increase total automotive accidents by about 1 percent.

[33] The econometric analysis reveals that vehicle-miles has an uncertain positive influence on total automotive injuries, although miles and injuries were directly related consistently throughout several statistical tests. The statistical problem may be a reflection of the way injuries are estimated and how they are reported.

However, for reasons already cited, it is difficult to believe that airline deregulation is solely responsible for all of the estimated reductions in accidents. Nonetheless, if airline deregulation had only half the estimated impact on highway safety, then there still were on average over 300,000 fewer automotive accidents per year because of airline deregulation.

Economic Cost

Automotive accidents impose economic costs on motorists in a variety of ways. Medical care and automotive repairs are the most visible. The lost national production, due to injuries and deaths, are not so apparent. In 1966, according to the National Safety Council, the estimated total economic cost from automotive accidents was slightly more than $33 billion (in terms of 1985 dollars). By 1985, the total economic cost escalated by 47 percent in real-dollar terms, to $48.6 billion.[34] While cost figures for various years may not be fully comparable, we estimate from the available data that vehicle miles of travel and economic loss from automotive accidents are nearly proportional: a 1 percent increase in travel leads to a 1.01 percent increase in economic cost (see Table A-6, equation 2).[35] Therefore, the 3.9 percent average reduction in passenger-car travel may have also reduced economic loss from automotive accidents by an annual average of 3.9 percent, or by $1.9 billion a year, in the 1979-1985 period. Again, even if airline deregulation had only half of this estimated effect, then economic losses avoided would be close to $1 billion.

---

[34] National Safety Council, Accident Facts: 1986 (Chicago: 1986), p. 4. The total economic loss includes $16.1 billion in lost wages, $3.9 billion in medical expenses, $9.3 billion in insurance administration, and $19.3 billion in property damage to motor vehicles. The cost estimates do not include the expenses incurred by public agencies (for example, policy and fire departments and courts), value of cargo losses to commercial vehicles, and damages awarded in excess of direct losses.

[35] The National Safety Council warns that its estimated cost of accidents in various years may employ different estimating techniques (Ibid.). For that reason, the estimated reduction in economic losses must

General Findings on Automotive Safety

According to our analysis, the reduced rate of growth in passenger-car miles due to increased air travel since airline deregulation has significantly improved travel safety. The estimates of improved highway safety for the 1979-1985 period reported above are summarized in Table 1.

Our research suggests that automotive safety gradually improved over the 1979-1985 period as air travel was progressively substituted for ground travel. We cannot state with statistical certainty how much of the measured safety improvements are attributable to airline deregulation. At the same time, our most conservative estimates of safety improvements are substantial.

In addition, we found, as anticipated, that the number of automotive accidents, and the deaths and economic losses related to them, is significantly and directly related to per capita alcohol consumption (measured in real dollar terms) and is significantly and negatively related to the growing percentage of female drivers.[36] That is, the observed

---

be considered rough.

[36] The Brookings researchers did not find that per capita alcohol consumption, measured in gallons per year, was a statistically significant determinant of automotive deaths. Because alcohol consumption, measured in real dollar terms, and automotive deaths are strongly related in our analysis, we are inclined to believe that the "safety" and "weight"

long-run downward trend in automotive deaths is also partially attributable to the reduction in per capita alcohol consumption and to the growing percentage of women drivers. In general, ongoing changes of ground travel between rural and urban roads did not significantly influence our measures of highway safety. Finally, our analysis also reveals that automotive safety is reduced by increases in speed, population, and income and by decreases in transportation prices.

CONCLUDING COMMENTS

Estimates of the impact of airline deregulation on ground-travel safety are only approximate, even under the best of conditions. Nonetheless, the statistical analysis undertaken is useful for two reasons. First, it indicates, at the very least, the general direction of the change in automotive safety due to airline deregulation. Our findings support our expectations of a positive relationship between airline deregulation and highway safety.

Second, the analysis provides rough estimates of the actual impact. While acknowledging the imprecision in the statistical findings, we are confident that airline deregulation has significantly reduced ground travel and, in turn, the reduction in ground travel has significantly reduced automotive accidents, injuries, deaths, and economic loss.

Although we relied on the most conservative estimates, we suspect that our reported estimates of the benefits of airline deregulation on highway

---

variables included in the Brookings study pick up a part of the impact of alcohol consumption (Crandall, et al., Regulating the Automobile, pp. 63 and 64).

safety may represent the upper bounds of the true effects.[37] By the same token, it is difficult to believe that roadway safety is not significantly and directly influenced -- holding all other major influences constant -- by the amount of travel. Our findings leave substantial margin for statistical imprecision without disturbing our more general conclusion: During the 1979-1985 period, airline deregulation has each year significantly lowered automotive accidents (measured in hundreds of thousands), fatalities (measured in hundreds), and economic losses (measured in hundreds of millions of dollars).

Unless legislative precautions are taken, reregulation of the airline industry could drive some air travelers back to the nation's roads and could increase ground-travel accidents, injuries, deaths, and economic losses. Even if airline reregulation resulted in improved air safety, overall travel safety could be reduced.

---

[37] This may be so because the statistical techniques used may overstate the impact of airline deregulation. A part of the measured reduction in miles driven may actually be due to, say, greater use of telephones, and a part of the measured improvement in highway safety due to safety improvements in vehicles and roads. As we have noted, the computed percentage impact of airline deregulation on miles of ground travel and the percent impact of miles of travel on measures of safety varies significantly with the combination of variables used, a point that is made clear in tables in the appendices containing the regression equations.

APPENDIX: ECONOMETRIC ANALYSIS

INTRODUCTION

In this appendix we specify the econometric model we used to obtain the estimates reported in the text and present the detailed results of estimation of that model. Our model is a two equation recursive model that first assesses the impact of airline deregulation on ground travel and then the impact of ground travel on one of the following measures of highway safety: deaths, accidents, or costs. The guiding argument is airline deregulation must affect highway safety through its impact on highway usage and congestion.

SPECIFICATION OF THE MODEL

As explained in the text, theory suggests that ground miles traveled should depend on a limited number of variables: the relative price of ground travel as measured by the private transportation price index (PT), real disposable income per capita (DIPC), population (POP), and average highway speed (SPEED). Also, if in fact airline deregulation has, on balance, influenced the volume of ground travel, an additional variable that measures the influence of deregulation should prove significant.

Two different measures of the influence of deregulation were explored. One measure is a dummy variable (DEREG) for the deregulation period. DEREG has a value of 1 for years 1975-85 and 0 for the early period. The second measure is a Spline variable for "time since deregulation" (TSD). For each year since deregulation, TSD equals year minus 1978; for all preceding years TSD is 0. This Spline measure allows the effect of airline deregulation to grow with time. Since any effect of airline deregulation on ground travel was probably not instantaneous, this measure is expected to fit the data better than the DEREG dummy.

Ground travel, in turn, can affect deaths, accidents, and accident costs. In addition, holding the amount of ground travel constant, other variables may affect deaths, accidents, and costs. We initially assumed these additional variables would include alcohol consumption per capita (ALCOPC), the percentage of drivers who are female (PCTFEM), the percentage who are less than 20 years old (PCTLT20), and the ratio of urban to rural travel (URBRUR). ALCOPC should be positively related to deaths, accidents, and costs. Because female drivers have historically been less accident-prone than their male counterparts, we expect that PCTFEM will be inversely related to deaths, accidents, and costs, while we anticipated that PCTLT20 will be positively related. The variable URBRUR is included to control for any effect that changes in the composition of driving might have on deaths, accidents, and costs. We have no strong prior about the sign of this variable.

The initial specification of the miles traveled/deaths model is thus:
$M_t = a_0 + a_1PT_t + a_2DIPC_t + a_3POP_t + a_4SPEED + a_5DEREG_t + u_{1t}$
$D_t = b_0 + b_1M_t + b_2ALCOPC_t + b_3PCTFEM_t + b_4PCTLT20 + b_5URBRUR_t + u_{2t}$, where M_t is ground miles traveled at time t, D_t is automotive deaths at time t, and $u^1{}_t$ and u_{2t} are random errors. In the alternative version of the model, the variable TSD replaces the variable DEREG in the first equation. Models for accidents (A) and accident costs (C) simply replace D_t with A_t and C_t, respectively, in the second equation. As formulated, the model is

recursive, and both equations may therefore be estimated by ordinary least squares.[38]

An alternative specification was also considered. Our theory suggests that SPEED influences miles traveled directly through its effect on the cost of ground travel. SPEED therefore affects highway deaths partly through its effect on miles traveled. However, holding miles traveled constant, SPEED may also affect deaths directly. If this is so, SPEED should also appear in the deaths equation. Results with SPEED in the second equation are also discussed below.

RESULTS FOR HIGHWAY TRAVEL

Our estimation of the impact of airline deregulation on miles traveled is based on data for a 20-year period, 1966-1985.[39] Tables A-1 to A-4 show the results of the miles-traveled equation for four different measures of ground travel: total vehicle miles, total car miles, urban car miles, and rural car miles. Results without an airline deregulation measure are displayed in column 1; results with the DEREG dummy and then the spline variable TSD are reported in columns 2 and 3, respectively. All continuous variables are measured in logarithms; therefore the coefficients may be interpreted as measures of elasticities. All equations were correcte r autocorrelation by the Prais-Winsten method. Durbin-Watson statistics for the transformed equations are provided in the tables. For the most part, the Durbin-Watson statistics for the transformed equations are either insignificant or are in the indeterminate range.

---

[38] The model would become simultaneous if deaths affect miles traveled as well as miles traveled affecting deaths. Deaths might in fact influence miles traveled by affecting drivers' perceived injury risks. In unreported results of a simultaneous equations estimation of the model with deaths included on the righthand-side of the miles driven equation, we found no evidence that deaths affect miles traveled. The model is thus recursive.

[39] The period of analysis was determined by the availability of consistent highway travel data obtained from Federal Highway Administration, Highway Statistics: Summary (Washington: U.S. Government Printing Office, 1987).

Table A-1 contains the results for equations with miles traveled by all vehicles as the dependent variable. Although the DEREG and TSD variables in the last two columns, respectively, have negative coefficients, the estimates are not statistically significant. Hence total vehicle miles do not appear to have been significantly affected by airline deregulation. As noted in the text this result is not totally unexpected, given that trucking was deregulated at approximately the same time as airlines. After deregulation, increased truck miles may have offset reductions in car miles. Therefore, we turn to the estimated effects of deregulation on total car miles and car miles traveled on urban and rural roads, respectively.

The results of our analysis of passenger-car miles are displayed in Tables A-2 through A-4. In all cases, the deregulation variables (DEREG and TSD) are negative and statistically significant. For instance, the coefficient for DEREG in TABLE A-2 indicates that airline deregulation reduced passenger vehicle miles by -.039, or by 3.9 percent. The coefficient on the Spline variable TSD indicates an annual reduction in miles traveled of approximately -.014, or 1.4 percent, relative to what miles would have been the case in the absence of airline deregulation. The cumulative effect by 1985 is 9.8 percent (or 7 x -.014). Estimates from the urban and rural miles traveled equations are strikingly similar.

Table A-1. Equations For Total Vehicle Miles, 1966-1985

Independent Variable	Equations 1	2	3
Intercept	-6.478 (4.859) [.182]	-11.753 (8.274) [.084]	-15.720 (9.027) [.082]
Transportation Price	.469 (.277) [.090]	.713 (.454) [.042]	.383 (.277) [.167]
Real Per Capita Income	1.671 (.347) [.001]	1.488 (.496) [.001]	1.219 (.506) [.016]
Population	.135 (.636) [.833]	.720 (.991) [.475]	1.169 (1.063) [.271]
Speed	.917 (.234) [.001]	.859 (.328) [.001]	1.075 (.260) [.001]
DEREG		-.045 (.044) [.277]	
TSD			-.008 (.006) [.229]
Durbin-Watson	2.297	2.790	2.370
R^2	.978	.979	.979

Notes:

Standard errors in parentheses.
Significance levels in brackets.

Table A-2. Equations For Total Passenger Car Miles Traveled, 1966-1985

Independent Variable	Equations 1	2	3
Intercept	-14.323	-16.775	-21.196
	(3.691)	(2.984)	(3.401)
	[.001]	[.001]	[.001]
Transportation Price	-.505	-.311	-.694
	(.178)	(.143)	(.116)
	[.009]	[.029]	[.001]
Real Per Capita Income	.183	.211	.065
	(.209)	(.156)	(.186)
	[.348]	[.173]	[.728]
Population	1.955	2.146	2.577
	(.414)	(.319)	(.393)
	[.001]	[.001]	[.001]
Speed	.606	.570	.684
	(.141)	(.105)	(.109)
	[.001]	[.001]	[.001]
DEREG		-.039	
		(.011)	
		[.001]	
TSD			-.014
			(.003)
			[.001]
Durbin-Watson	.742	1.703	1.918
R^2	.990	.994	.997

Notes:

Standard Errors in Parentheses.
Significance levels in brackets.

Table A-3. Equations For Urban Passenger Car Miles Traveled, 1966-1985

Independent Variable	Equations 1	2	3
Intercept	-25.795 (4.985) [.001]	-23.832 (3.936) [.001]	-34.041 (4.825) [.001]
Transportation Price	-.649 (.253) [.010]	-.368 (.222) [.097]	-.813 (.165) [.001]
Real Per Capita Income	.332 (.297) [.264]	.833 (.241) [.005]	.208 (.264) [.430]
Population	2.741 (.573) [.001]	2.244 (.473) [.001]	3.480 (.557) [.001]
Speed	.578 (.200) [.004]	.373 (.163) [.022]	.657 (.155) [.001]
DEREG		-.064 (.020) [.002]	
TSD			-.017 (.004) [.001]
Durbin-Watson	1.956	2.075	1.934
R^2	.992	.996	.997

Notes:

Standard Errors in Parentheses.
Significance levels in brackets.

Table A-4. Equations For Rural Passenger Car Miles Traveled, 1966-1985

Independent Variable	Equations 1	 2	 3
Intercept	-1.033 (3.793) [.785]	-1.488 (3.455) [.666]	-8.438 (3.952) [.032]
Transportation Price	-.373 (.201) [.063]	-.182 (.186) [.329]	-.625 (.165) [.001]
Real Per Capita Income	.108 (.237) [.649]	.117 (.202) [.549]	-.199 (.218) [.359]
Population	.697 (.447) [.119]	.906 (.393) [.021]	1.641 (.458) [.001]
Speed	.591 (.160) [.001]	.566 (.137) [.001]	.758 (.126) [.001]
DEREG		-.037 (.015) [.013]	
TSD			-.013 (.003) [.001]
Durbin-Watson	1.903	1.591	1.921
R^2	.943	.950	.975

Notes:

Standard Errors in Parentheses.
Significance levels in brackets.

In passing, note that the transportation price variable PT is negative and statistically significant in almost all of the car miles equations. However, it is positive but not significant in the total vehicle miles equation. Per capita income is estimated to have a significant positive effect on total miles but not on private passenger miles. Population and speed are estimated to have significant positive effects in all of the equations for passenger-car miles. Speed is also significant in the equation for total vehicle miles, although population is not significant.

Our finding of a negative relationship between airline deregulation and passenger-car travel could mirror, in part, a shift in driving patterns that emerged with the OPEC oil embargo in 1974 and is not reflected in the transportation price index.[40] In equations not reported, we included dummy variables for both the OPEC embargo (1966-1973=0; 1974-1984=1) and airline deregulation. However, the changes left our basic findings undisturbed. The coefficient for the deregulation dummy retained its statistical significance (at less than the .05 confidence level) and was approximately the same as before (.0383). At the same time, the oil embargo dummy was positive (contrary to expectations) but statistically insignificant (at a confidence level of .861). We then replaced the deregulation dummy with the embargo dummy. The embargo dummy was again positive and statistically insignificant.

---

[40] Crandall, et al., found a statistically significant impact for the OPEC embargo for the years 1974-1981. However, we suspect that their embargo dummy may have been picking up some of the impact of airline deregulation.

RESULTS FOR HIGHWAY SAFETY

Our estimations of the impact of automotive travel on highway safety are based on data from the 1966-1984.[41] Tables A-5 through A-7 show the equations for deaths, accidents, and costs. Tables A-4 and A-5 show results of estimation of the effects of car miles on total highway deaths and car deaths.[42] The estimated coefficients range from .895 to 1.180 and are significant at the .08 level or better. It is clear from these results that car miles traveled directly affect automotive deaths. Furthermore, the relationship is approximately proportional, meaning that a 1 percent increase in travel leads to roughly a 1 percent increase in automotive deaths (give or take .1 or .2 percent).

Notice that inclusion of the variable URBRUR in the equations has the effect of increasing the estimated impact of car travel on deaths. However, this variable is not significant at conventional levels. Therefore, we use the more conservative estimates of the impact of miles traveled on deaths in our policy analysis.[43]

---

[41] The analysis could not be extended to 1985 (which is the last year of analysis for the earlier estimations of ground travel) because data on alcohol consumption in real dollar terms was unavailable for 1985.

[42] Further analysis of the impact of total vehicle miles on highway safety was not undertaken because airline deregulation was found to be an insignificant determinant of total vehicle miles.

[43] We also estimated the effect of total vehicle miles on total deaths. The results, which are not displayed, indicated that total vehicle miles have an insignificant positive impact on total deaths. The finding that deaths depend on car miles but not total vehicle miles are not implausible because the variation in car miles in the early 1980s may have been offset by offsetting variations in, for example, truck and bus miles driven and because the death rate per mile driven is generally lower for trucks and buses than cars.

Table A-5. Equations for Highway Deaths, 1966-1984

Independent Variable	Equations Total Deaths			Car Deaths
	1	2	3	4
Intercept	5.159	4.401	1.245	.802
	(9.621)	(9.813)	(12.207)	(12.602)
	[.592]	[.646]	[.919]	[.949]
Car Miles	.895	1.013	.992	1.180
	(.443)	(.467)	(.561)	(.593)
	[.043]	[.030]	[.077]	[.046]
Alcohol Consumption Per Capita	1.127	1.121	1.051	1.087
	(.471)	(.477)	(.593)	(.601)
	[.017]	[.019]	[.076]	[.071]
Percent Female	-3.753	-2.948	-5.583	-4.099
		(1.290)	(1.491)	(1.576)
(1.791)				
	[.004]	[.048]	[.001]	[.022]
Percent Less Than Age 20	-.309	-.370	-.257	-.399
	(.280)	[.281]	(.325)	(.311)
	[.269]	(.187]	[.428]	[.199]
Urban/Rural Miles		-.449		-.841
		(.436)		(.541)
		[.302]		[.120]
Durbin-Watson	1.339	1.402	1.767	1.875
R^2	.709	.774	.907	.909

Notes:

Standard errors in parentheses.
Significance levels in brackets.

In passing, note that alcohol consumption per capita is significantly and positively related to deaths, while the percent of drivers who are female is significantly negatively related. Contrary to expectations, the percent of drivers less than 20 years of age is estimated to have a negative effect on deaths. However, this variable is not significant in any of the equations in Table A-5.

Because there may exist significant trend-related variables omitted from the equations in Table A-5, there is the possibility that the results in Table A-5 are biased. We therefore reestimated the deaths equations in first-difference form with intercepts included. The intercept coefficients will capture the effects of omitted trend-related variables. The results, which are shown in Table A-6, remain substantially unchanged from those presented in Table A-5 and provide further support for the finding that there is an approximately proportional relationship between car miles and highway deaths.

We turn now to the effects of car miles on accidents and accident costs in Table A-7. Increased car miles in equations 1 and 2 of Table A-7 clearly lead to increased accidents. The estimated effect of car miles is significant at the .01 level in both equations. Again, the effect is approximately proportional (although, as before, the estimate rises when URBRUR is included in the equation). The accident equation in column 2 is the only one in which the URBRUR variable is found to have a statistically significant effect. In that equation our estimate is that a rise in urban driving relative to rural driving serves to reduce accidents. Unlike the deaths, ALCOPC and PCTFEM have the expected signs, but do not appear to be significantly related to accidents. The estimated effect of alcohol

Table A-6. Equations for Highway Deaths, First-Differences, 1966-1984

Independent Variable	Equations Total Deaths 1	 2	 Car Deaths 3	 4
Intercept	-.001	.003	-.026	-.023
	(.026)	(.026)	(.030)	(.031)
	[.968]	[.902]	[.381]	[.461]
Car Miles	.968	1.042	1.093	1.167
	(.432)	(.444)	(.542)	(.574)
	[.025]	[.019]	[.044]	[.041]
Alcohol Consumption Per Capita	.653	.899	.670	.849
	(.369)	(.429)	(.513)	(.573)
	[.077]	[.036]	[.173]	[.139]
Percent Female	-4.553	-4.559	-3.793	-4.014
	(2.069)	(2.068)	(2.599)	(2.687)
	[.028]	[.028]	[.145]	[.135]
Percent Less Than Age 20	-.435	-.373	-.671	-.633
	(.348)	(.351)	(.444)	(.459)
	[.211]	[.288]	[.131]	[.167]
Urban/Rural Miles		-.065		-.045
		(.062)		(.076)
		[.292]		[.544]
Durbin-Watson	1.943	2.023	1.989	2.024
R^2	.624	.659	.597	.600

Notes:

Standard errors in parentheses.
Significance levels in brackets.

consumption on accidents may be partially muted by numerous small accidents that do not involve drinking. Again, PCTLT20 is insignificant in the equations in Table A-7.

We found (equations 3 and 4 in Table A-7) that car miles are also significantly and directly related to accident costs. In equation 3 of Table A-7, which excludes URBRUR, the effect is again significant and approximately proportional. In the costs equations, ALCOPC once again has a highly positive, significant effect. Although the PCTFEM and PCTLT20 have the expected signs, they are not significant. Neither is the variable URBRUR in equation 4. In addition, the inclusion of URBRUR appears to seriously distort (upward) the estimated effect of car miles on costs. In our view the small estimate, 1.010, obtained without including URBRUR, is more tenable, especially since URBRUR is not significant in equation 4.

Finally, we noted earlier that SPEED might also belong in the equations with deaths, accidents, and costs as dependent variables, as well as the miles traveled equations. The conjectured direct relationship of highway speed to highway safety was a matter of casual observation, rather than economic theory. When a SPEED variable was included it was never statistically significant; however, its inclusion substantially reduced the magnitude and statistical significance of the car miles variable and, in some cases, reversed the sign. We suspect that the effect of SPEED is approximated in part by the other variables in the same equation, giving rise to a problem of multicollinearity.[44] In addition, SPEED may also rise

---

[44] For instance, when we regressed the natural log of SPEED on ALCOHOL, PCTFEM, and PCTLT20, SPEED was found to be significantly related to all three independent variables at the .03 level or higher. Therefore, SPEED is a significant determinant of the other variables in the deaths equation as well as in the travel equation. These findings suggest that ALCOPC,

Table A-7. Equations for Accidents and Costs, 1966-1984

Independent Variable	Equations			
	Accidents		Costs	
	1	2	3	4
Intercept	-9.837 (5.671) [.083]	-13.941 5.653 [.022]	3.847 (7.285) [.597]	-12.221 (10.987) [.266]
Car Miles	.921 (.261) [.001]	1.158 (.264) [.001]	1.010 (.244) [.001]	1.883 (.522) [.001]
Alcohol Consumption Per Capita	.079 (.276) [.773]	.006 (.268) [.983]	1.503 (.525) [.004]	1.336 (.534) [.012]
Percent Female	-.657 (.732) [.369]	-.011 (.782) [.987]	-.495 (.786) [.520]	-2.666 (1.665) [.109]
Percent Less Than Age 20	-.046 (.151) [.760]	-.168 (.134) [.209]	.281 (.313) [.369]	-.056 (.312) [.857]
Urban/Rural Miles		-.553 (.236) [.020]		.078 (.487) [.872]
Durbin-Watson	1.664	1.982	1.977	1.894
R^2	.955	.971	.936	.929

Notes:

Standard errors in parentheses.
Significance levels in brackets.

and fall with a host of other highway safety conditions that could not be included in the analysis.[45]

Finally, our variable for passenger car miles may be reflecting ongoing safety improvements in automobiles resulting from forces and government mandates during the 1970s and 1980s. As noted in the text, Graham found substantial safety improvements in automobiles.[46] However, when Graham's safety index was included in our basic equation for highway deaths (Table A-5, equation 1), our basic findings remained unchanged. The coefficient for passenger-car miles remained positive and statistically insignificant (at the .671 level). When the safety index was included, along with variables for the average age of automobiles, the size of automobiles (as measured by their average fuel economy), and the percentage of miles driven by trucks, severe multicollinearity problems arose. The coefficient for passenger-car miles was insignificant (at the .187 level), but it was still positive and higher (1.08) than our reported estimate in Table A-5, equation 1.[47]

---

[45] For example, we suspect that highway speed may rise with an increase in the width and number of lanes on highways. Given the width and number of lanes, an increase in highway speed might lead to more accidents and deaths. However, we were unable to develop a satisfactory means of controlling for the multiplicity of factors like the width and number of lanes.

[46] Graham found that relative to 1965, the "crashworthiness" of automobiles exhibited the following improvements: 4 percent for 1966 and 1967; 19 percent for 1968 and 1969; 24 percent for 1970 and 1971; 28 percent for 1972 and 1973; and 34 percent for 1974 and all following years [Graham, "Automotive Safety: An Investigation of Occupant Protection Policies," table 3-11, as reported in Crandall, et al., Regulating the Automobile, p. 62].

CONCLUDING COMMENTS

Our empirical work has been necessarily limited by the availability of satisfactory measures of many factors that might influence highway safety. Furthermore, the impact of the airline deregulation variables on passenger-car miles driven and the impact of passenger car miles driven on highway safety varies with the specifications of the econometric models. At the same time, the variety of ways we sought to determine the indirect impact of airline deregulation on highway safety leads us to conclude that the expected impact is evident, and the impact is strong, both in terms of magnitude and statistical significance.

---

[47] When a trend variable (that might better represent the impact of safety improvements in both cars and roads) was introduced, the coefficient on car miles was close to 1 and positive but insignificant (at the .143 level).

Mandatory Child Safety Seats in Air Transport: Do They Save Lives?*

(Copyright 1990, The Journal of the Transportation Research Forum)

July 1990

Robert J. Windle and Martin E. Dresner
College of Business and Management
University of Maryland
College Park, MD 20742

FAX: (301) 454-0391
Telephone (Dresner): (301) 454-5612
Telephone (Windle): (301) 454-4077

* We would like to thank the participants of the University of Maryland's College of Business and Management workshop as well as Dr. Julian Simon of the College and Dr. Leonard Evans of General Motors Research Laboratories for their helpful comments.

Abstract

In February, a bill was introduced in the U.S. Congress to make the use of child safety seats mandatory on all airline flights. The law is clearly intended to make airline travel safer for the flying public. Currently, children under the age of two can fly for free if they sit on the laps of fare paying passengers. The requirement that all children under two must be placed in child safety seats means that these children must now occupy their own airline seats. The seats can either be sold to the families with small children or the increased cost can be passed on to all fare paying passengers with the seats given away to the families with small children. Thus, one of the consequences of mandatory child safety seats is to raise the average airline fare. This fare increase will cause some travellers to switch from flying to driving. Since automobile travel is more likely to result in fatalities than airline travel, the resulting diversion of passengers will actually contribute to an increase in travel deaths on the highway. Unless the lives saved due to the mandatory child safety seats exceeds the additional lives lost due to traffic diversion, there will be a net increase in lives lost due to the policy.

This paper uses existing information on travel elasticities and fatality rates to determine the net effect of mandatory child safety seats. It is shown that under almost any assumptions regarding elasticities and fatality rates that mandatory child safety seats will result in an increase in lives lost among the travelling public.

It is important to note that this paper, unlike previous work on this subject, did not attempt to weigh the costs of mandating child safety seats against the benefits of such a policy. This type of analysis was not necessary since, as the paper has demonstrated, there are no benefits. There are, however, costs to such a policy, including an increase in lives lost and the inconvenience to travellers diverted from the air system to the highways.

I. Introduction

On February 20, 1990, a bill was submitted to the House of Representatives requiring the use of child safety seats on commercial airline flights in the United States for all children under two years of age (United States, House of Representatives, 1990). The proposal resulted from concern over the safety of young children on commercial flights. Currently, children under two years of age are not required to wear restraining devices. The typical practice is for an adult to purchase a ticket and then to carry the young child in his or her lap, thus saving the price of a ticket for the child.

The bill before the House of Representatives is just one of a number of proposals designed to increase the safety of young children on U.S. commercial flights through the use of safety seats. Other proposals have been put forward by the Federal Aviation Administration (FAA) (Federal Aviation Administration, 1990), The Air Transport Association of America (Air Transport Association of America, 1990), the Association of Flight Attendants (Gilmer, 1989) and the Ralph Nader affiliated Aviation Consumer Action Project (Aviation Consumer Action Project, 1985).[1]

---

[1] It should be noted that the FAA proposal only calls for air carriers to permit the optional use of federally-approved child safety seats.

This paper examines whether or not mandating the use of child safety seats on flights will in fact save lives. The major premise of the analysis is that mandatory child safety seats will raise the price of airline tickets (either directly for the families affected or indirectly for the entire travelling public). The increased price will result in the diversion of some traffic from airlines to automobiles. Given that highway travel is less safe than air travel, the mandatory use of child safety seats in air transport will result in an increase in the number of lives lost.

In the next section of the paper, previous studies of the costs and benefits of child safety seats are examined. Section 3 presents the model used for this paper and the results of the analysis. Finally, Section 4 draws policy conclusions from the study results.

II. Literature Review

The most comprehensive study of the costs and benefits of child safety seats has been conducted by the FAA and released as part of the Administration's recent proposal for changes to safety seat regulations (Federal Aviation Administration, 1990).[2] In conducting its analysis, the FAA assumed that safety seats would be made mandatory for all children under the age of 5 years. It estimated the average adult ticket price at $118.30, and assumed that in accordance with pricing policies of several U.S. carriers, that children under 5 years of age could fly at half price. The FAA also assumed that the safety seats would be provided on a rental basis by carriers at a cost of $3.00 per child.

---

[2] A second cost-benefit analysis was conducted by the Aviation Consumer Action Project (1985). This analysis examined the impact of requiring airlines to make child safety seats

The FAA recognized that the increased cost of travel due to the purchase of extra tickets for children and the rental cost of the child seats would reduce the number of families who travel by air. The FAA estimated that without mandatory safety seat regulations, a family of 4, including one child under 2 years of age and one between 2 and 5 years old, would pay on average $295.75 for a trip (i.e., two adult tickets plus one half-fare child ticket). With the mandatory safety seat regulations, the family's tab would increase to $357.90, the difference being a half price ticket and the rental of 2 child seats. Given the FAA's price elasticity measure of -.8218, and an estimate of 4,010,000 children under the age of 2 currently flying, this would imply that 700,000 fewer families would use air transport.

---

available for the optional use of its passengers. Based on the optional assumption, the Aviation Consumer Action Project determined that there would be no cost to travelers of this plan, and that carrier costs would be limited to the costs of acquiring the necessary child safety seats ($44,000 per year). The conclusion was that this was a small cost to pay for the potential lives saved. Their cost-benefit analysis did not evaluate the mandatory safety seat option.

The FAA then calculated the cost of the safety seat requirement as (4,010,000 - 700,000) * ($357.90 - $295.75) or over $200 million per year.

On the benefit side of the equation, the FAA did not conduct a formal analysis but estimated that over the last 15 years, there were 8 accidents involving infants and children in which the use of child safety seats may have reduced casualties. Using National Traffic Safety Administration data which show auto safety seats are 69 percent effective in preventing injuries and deaths in automobile accidents, the FAA calculated that 3 or 4 of the 5 infant and small children fatalities in survivable air crashes could have been saved. In addition, it was estimated that three injuries and one fatality that occurred in non-crash situations could have been prevented. Although no dollar values were assigned to the potential lives and injuries saved, the FAA concluded that the benefits could not justify the cost expenditures to make the seats mandatory.[3]

The FAA study can be faulted on at least two major counts. First, from society's perspective, it is evident that the FAA vastly overstated costs. The figure cited by the FAA is a cost to travelers, not to society. The additional payments by the travelers can be considered as a benefit to other members of society, namely the airlines, so cannot be added into the calculation as a cost. In addition those who chose not to fly retained the money they would have otherwise spent on their tickets and used this money for other purposes.[4] Secondly the FAA also vastly overstated the benefits. Presumably a proportion of those discouraged from travelling by air due to the additional cost of the child safety seats will choose another means of transportation. If the choice is to travel by auto, which is less safe than air, than there will be additional lives lost on the highway.

---

[3] An earlier estimate of benefits by the FAA based on the saving of 5 children's lives valued the benefits at $500,000 per year. See the Federal Aviation Administration (1982).

III. Analysis

The approach used for this study is to compare the risks, in terms of potential lives lost, under the current system of allowing children under 2 to fly free with a proposed system of requiring adults to purchase tickets for these children.[5] The probability of a passenger losing his or her life in an air accident is given by the following equation:

---

[4] A real cost to society would result from losses to the 700,000 families who were forced to travel by a less convenient method (e.g. by auto) or were discouraged from traveling at all. The difference in value between air travel and the next best use of their dollars would be considered a loss.

[5] This type of study, in which the risks of different alternatives are compared, is known as a risk - risk analysis. For a discussion of the strengths and weaknesses of the risk - risk analysis, see Lave (1981, pp. 15-17).

$$\Pr(\text{Losing Life}) = \Pr(\text{Air Crash}) * \Pr(\text{Dying in Plane that Crashes}) \qquad (1)$$

Using historical data, it is possible to provide an estimate of (1) with the following equation:

$$\Pr(\text{Losing Life}) = \frac{\text{Fatal Accidents}}{\text{Miles Flown}} * \frac{\text{Ave. No. Fatalities}}{\text{Ave. No. Passengers}} \qquad (2)$$

Equation 2 may then be reduced to the following:

$$\Pr(\text{Losing Life}) = \frac{\text{Fatalities}}{\text{Passenger-Miles}} \qquad (3)$$

Equation (3) may also be used to calculate the chances of being involved in a fatal automobile accident. By comparing the results of equation 3 for automobiles and air transport, one can determine whether the diversion of passengers from air to automobiles, as a result of the institution of mandatory child safety seat regulations, will increase or decrease fatalities.

A. Base Case:

The assumptions for the base case of the analysis are as follows:

- Three hundred thousand families per year will be diverted from air travel to automobile travel. This number is lower than the 700,000 family figure used by the FAA since it reflects only families who will choose not to fly and choose to drive to their destination instead.[6]

- The 300,000 families have an average of 2 adults and 2 children with one child under the age of 2, as per the FAA study.
- The average trip for a family diverted from air to auto is 765 miles, equivalent to the average air passenger trip length.

Using data from the 1989 edition of the Statistical Abstract of the United States, the following fatality probabilities can be computed for air and auto travel:[7]

---

[6] The 300,000 family figure was calculated based on the modal choice elasticity of .378 computed for air travellers by Morrison and Winston (1985, p. 226). The figure represents the percentage of leisure travellers who will choose to travel to their destination by another mode of transportation if the price of air transport rises by 1 percent. Therefore, if an elasticity of .8218 results in the diversion of 700,000 families, an elasticity of .378 should result in the diversion of about 321,000 families. Since, according to Morrison and Winston's model, approximately 93 percent of those leisure travellers diverted to another mode will be diverted to automobile, the lower figure of 300,000 families was used.

[7] The average number of passengers travelling in an automobile on a U.S. highway was assumed to be 2 for the calculation of automobile passenger-miles. This figure approximates the 1.914 leisure passengers per automobile estimated by Morrison and Winston (1985, p. 220) in their modal choice model.

Air: $$\text{Pr(Losing Life)} = \frac{\text{Fatalities}}{\text{Passenger-Miles}} = \frac{89}{\text{339 Billion}}$$

$$= \text{0.264 fatalities per billion passenger-miles} \qquad (4)$$

Auto: $$\text{Pr(Losing Life)} = \frac{\text{Fatalities}}{\text{Passenger-Miles}} = \frac{43{,}928}{\text{3,432 Billion}}$$

$$= \text{12.80 fatalities per billion passenger-miles} \qquad (5)$$

The effect on fatalities due to the diversion of passengers to auto may then be given by the following equation:

$$\begin{array}{l}\text{Change in Fatalities} = \left[\begin{array}{c}\text{Passengers}\\ \text{Diverted}\end{array} * \begin{array}{c}\text{Average Trip}\\ \text{Length}\end{array}\right] * \left[\begin{array}{c}\text{Auto Fatality}\\ \text{Rate}\end{array} - \begin{array}{c}\text{Air Fatality}\\ \text{Rate}\end{array}\right]\end{array}$$

$$= [(1{,}200{,}000 \text{ Passengers} * 765 \text{ Miles}) * (12.8 - .264) \text{ Fatalities per Billion Passenger-Miles}] / \text{billion}$$

$$= \text{11.5 fatalities per year} \qquad (6)$$

The probability of a loss of life in air transport would decrease, once the child safety seat legislation is implemented. The FAA has estimated that over a 15 year period there were 4 - 5 lives which may have been saved if the children had been using safety seats, a rate of 0.3 lives per year.[*] Therefore the net effect of the regulatory change would be to increase fatalities by 11.2 persons per year.*

---

[*] See the discussion in the Literature Review.

B. Sensitivity Analysis:

The results above indicate that under the assumptions of the base case, a regulatory change requiring the mandatory use of child safety seats would result in the loss of 11.2 extra lives per year. It is possible that these results may change under different assumptions, so a sensitivity analysis is appropriate. The assumptions that will be examined include: the number of families diverted to automobile; the driving characteristics of families diverted from air to auto; and, the assumption that adults must pay extra for the ticket of their child under 2 years of age.

1. The Level of Passenger Diversion

The first row of Table 1 provides a breakdown of the lives that will be lost at different levels of diversion from air to auto, given the family profile developed in the base case. Estimates of increased fatalities are provided for traffic

---

* It should be noted that the case against mandating the usage of child safety seats in air transport is even stronger from an _injury_ point of view. Using data from the _Statistical Abstract of the United States_ (United States, Department of Commerce, 1989, p. 590), it is clear that whereas in air transportation the injury rate is only one-half the death rate, in automobile transportation, the injury rate is 39 times the death rate. From an injury point of view, air transport has an even greater safety advantage over auto transport, than from a fatality viewpoint.

TABLE 1

NET INCREASE IN ANNUAL FATALITIES DUE TO THE MANDATORY USE OF CHILD SAFETY SEATS

	Traffic Diverted (000's of passengers)										
Assumptions	2200	2000	1800	1600	1400	1200	1000	800	600	400	200
Base Case:	20.8	18.9	17.0	15.0	13.1	11.2	9.3	7.4	5.5	3.5	1.6
Conservative Base Case:											
Airline Passenger Profile	15.6	14.2	12.7	11.3	9.8	8.4	6.9	5.5	4.0	2.6	1.1
Airline Passenger Profile + Rear Seat Allowance	13.5	12.2	11.0	9.7	8.5	7.2	6.0	4.7	3.5	2.2	1.0
Airline Passenger Profile + Rear Seat Allowance + Interstate Travel	5.3	4.8	4.3	3.8	3.3	2.8	2.2	1.7	1.2	0.7	0.2
Airline Passenger Profile + Rear Seat Allowance + Interstate Travel + No Alcohol For Driver	2.9	2.6	2.3	2.0	1.8	1.5	1.2	0.9	0.6	0.3	0.0
Conservative Base Case + Heavy Car Effect	1.9	1.7	1.5	1.3	1.1	0.9	0.7	0.5	0.3	0.1	-0.1
Conservative Base Case + Short Air Trip Assumption	1.1	1.0	0.8	0.7	0.6	0.5	0.3	0.2	0.1	0.0	-0.2
Conservative Base Case + Driver and All Passengers Use Safety Belts	1.1	0.9	0.8	0.7	0.6	0.4	0.3	0.2	0.1	-0.1	-0.2

diversions ranging from a high of 2,200,000 to a low of 200,000, with the midpoint (1,200,000) being the best estimate. It can be seen that even at the lowest level of traffic diversion of 200,000 passengers - one-sixth of the most probable estimate - there will be an annual increase in lives lost of 1.6 due to the use of mandatory child safety seats.

2. Driving Characteristics of Diverted Passengers

a) Airline Passenger Profile

Evans, Frick, and Schwing (1990) suggest that it is inappropriate to use average driving statistics when discussing the driving profiles of diverted airline passengers. The authors suggest a diverted airline passenger, as an automobile driver, is only 76 percent as likely to die in an automobile crash as an average automobile driver. The difference is due mainly to the older age profile of typical airline travellers as compared to automobile drivers. When factoring the safer driving record of diverted airline passengers into the fatality equation (6), the findings are that the required use of child safety seats will result in an increase of 8.4 fatalities per year (see Table 1, row 2).

b) Rear Seat Allowance

Evans and Frick (1988) found that the fatality rate of rear automobile passengers was 26 percent lower than the rate for front passengers.[10] Equation 6 was recalculated to account for the lower average fatality rate for a diverted family of four, given that two family members would likely be sitting in rear seats. The results are presented cumulatively with the airline passenger profile effect in the third row of Table 1. It can be seen from the table that the best estimate is that the mandatory use of child safety seats will result in an additional 7.2 deaths per year.

c) Interstate Travel Allowance

It is likely that a family diverted from air transport to automobile transport would travel to its destination, at least in large part, on interstate highways. Interstate travel is, on average, safer than travel in general.[11] Equation 6 was recalculated assuming all travel of diverted airline passengers is on interstate highways. When the interstate effect was cumulated with the two effects discussed above, the result was still an increase in deaths due to the mandatory use of child safety seats in air transport of 2.8 persons per year (see Table 1, row 4).

---

[10] This is assuming that the rear passengers occupy window seats. Center rear seats are approximately 15 percent safer than rear window seats. Given that the analysis is premised on a family of four being diverted from air to auto, it is likely that each of the children will occupy rear window seats.

[11] The interstate fatality rate was calculated as 5.44 deaths per billion passenger-miles compared to the average rate for all roadways of 12.8 deaths per billion passenger-miles. The rate was calculated using data from the Statistical Abstract of the United States 1989, (United States, Department of Commerce, 1989, p. 599) assuming an average of 2 passengers per vehicle. Note that the interstate fatality rate calculated for this paper was 42.5 percent of the fatality rate for all highways, a conservative estimate. Evans, Frick and Schwing (1990, pp. 242-243) calculated the fatality rate for interstate drivers to be 53 percent of the fatality rate for drivers on all roadways.

d) No Alcohol Effect

Although there is no firm evidence to suggest that it is the case, it may be that drivers with families diverted from airlines to automobiles are less likely to drive while intoxicated than drivers on average. Evans, Frick and Schwing (1990, p. 242) show that a driver who has consumed no alcohol is only 61 percent as likely to die in a fatal accident as a driver who has consumed some alcohol. The no alcohol effect was factored into Equation 6 along with the 3 other effects discussed above to arrive at a revised conservative base case, presented in row 5 of Table 1. It can be seen, that even under these very conservative assumptions, the mandatory use of child safety seats in air transport is still likely to result in an additional 1.5 lives lost per year. Even if only 200,000 passengers are diverted from air to auto - one-sixth of the most probable estimate - there will be no benefits to the mandatory use of child safety seats in air transport.

e) Heavy Car Effect

Three additional effects were added individually to the conservative base case to further examine the sensitivity of the results. The first was the heavy car effect. Evans, Frick and

Schwing (1990, p. 242) found that drivers travelling in cars 700 pounds heavier than the average car were only 73 percent as likely to be killed in a motor vehicle accident as drivers in cars of average weight. Although there is no evidence that diverted airline passengers travel in heavier than average cars, this effect was added to the conservative base case to determine a new fatality rate. The result, shown in row 6 of Table 1 indicates that even with the heavy car effect added to the conservative base case, there would be an additional 0.9 lives lost per year as a result of requiring the use of child safety seats in air transport.

f) Short Air Trip Assumption

It may be possible that a high percentage of the diverted passengers have been diverted from relatively short airline trips.[12] In their study, Evans, Frick and Schwing (1990) assumed that since a large percentage of airplane fatalities occur during take-offs and landings, the fatality rate should vary inversely with length of flight. For this scenario an airline trip of one-half the average trip distance was assumed for diverted passengers (one-half distance = 382.5 miles) as well as a corresponding fatality rate twice the average rate (twice the rate = 0.528 fatalities per billion passenger-miles). The new assumptions were factored into the conservative base case, with the results (Table 1, row 7) still indicating an increase in fatalities due to the mandatory use of child safety seats in air transport.

---

[12] There is in fact no evidence to suggest that this is the case. In fact the diversion rate may be lower for shorter air distances. A family that chooses to fly a short distance, rather than drive, may do so primarily on the basis of convenience rather than cost. Families with low discretionary income would not consider the flying option even if children under two could fly free. Increasing the cost of flying for families that choose to fly over short distances may have little diversionary effect.

g) Safety Belt Effect

Evans, Frick and Schwing (1990, p. 242) indicated that people who use safety belts in automobiles are only 49 percent as likely to die in automobile accidents as the average driver. Although there is no evidence to suggest that diverted airline passengers are more likely to use safety belts than the average driver, it was assumed that all diverted passengers wore safety belts. The results were factored into the conservative base case and are presented in Table 1, row 8. Again, even under this assumption, it is expected that mandating the use of child safety seats in air transport will result in an increase in fatalities of 0.4 persons per year.

3. Airlines Give Tickets to Children Under Two for Free

An alternative method of implementing a policy of mandatory child safety seats is to require the airlines to give seats away to families with children under the age of two. This policy would raise airline costs. Seats that were previously available for last minute travellers (and therefore sold at a very high price) would now be occupied by infants. In order to maintain the current number of unoccupied seats at any time prior to takeoff (i.e., maintain load factors), the airlines must increase the number of available seats. The airlines are most likely to pass this cost increase on to all airline travellers in the form of higher prices.

With an estimate of just over 4 million children under the age of 2 currently flying and an average ticket fare of $118.30, the potential lost revenue to the airline is approximately 475 million dollars.[13] This represents revenue lost from seats that are filled by non-paying children that could otherwise have been sold at the average fare. If airlines attempt to recoup this loss by raising the fares of the approximately 416 million domestic airline passengers enplaned in 1987, the resulting fare increase would be $1.14 per ticket.

Morrison and Winston (1985) computed price elasticities for both leisure and business travellers. As expected business travel was less elastic. Using their measure of the business elasticity to compute traffic diversion for the $1.14 fare increase leads to an estimated traffic diversion of over 635,000 passengers.[14] If it is assumed the diverted passengers fit the standard airline passenger profile and that all travel by the passengers takes place on the interstate highway system, an expected 1.6 lives per year will be lost due to the diversion of traffic from air to auto.[15]

---

[13] If we ignore airline profits, the revenue loss approximates the increased costs incurred by the airlines.

Requiring airlines to give tickets away to children under the age of two may be less costly to society in terms of additional lives lost, than requiring parents to pay for the tickets. Comparing the 1.6 expected lives lost under the "free ticket" policy to the expected lives lost under the "parent pay" policy (center column, Table 1) shows that depending on the assumptions made, fewer additional lives may be lost. It must be strongly noted, however, that both policies are expected to cost lives.

IV. Conclusions and Policy Implications:

This paper attempted to approach the issue of mandatory child safety seats from a perspective different from previous studies. Instead of examining the issue solely from the effect on air transport passengers, the paper also examined possible consequences due to the diversion of passengers from air to auto. Since the highway system is less safe than the air system, the diversion of passengers could have a net negative effect on transportation fatalities.

---

[14] The business elasticity measure was used in order to arrive at a conservative measure of traffic diversion. Morrison and Winston (1985) estimated the price elasticity of business travellers at -.18. But of those business travellers diverted from air travel, only 88 percent chose to travel by automobile. As a result, the elasticity used, above, is -.159 or -.18 x .88.

[15] This figure is net of the .3 lives per year expected to be saved due to the mandatory use of child safety seats on airplanes.

The conclusions from this analysis are clear - mandating the use of child safety seats will result in an INCREASE in fatalities, given the assumptions of the paper, and any reasonable scenario. Air passengers will be diverted to auto travel, and given auto travel's poorer safety record, more travellers will die in fatal accidents. Even when it is assumed that tickets for children under 2 will be given away for free, enough traffic will be diverted from the airways to the highways to increase the fatalities total. Only under unrealistically favorable assumptions will the safety seats even come close to saving as many lives in the air as they cost in lives diverted to auto traffic.

A much superior policy to mandating the use of child safety seats would be to allow for the optional use of the seats. This alternative policy would not result in the diversion of travellers from air to auto and would marginally decrease the fatality risk for children using the seats on airplanes.

It is important to note that this paper did not attempt to trade off the costs and benefits of mandating child safety seats. This was not appropriate, since as the paper has shown, THERE ARE NO BENEFITS. Given that there are no benefits, any cost is too high a price to pay for implementing this policy. These costs would include the loss in comfort and convenience to travellers diverted from air to auto as a result of higher fares and the lost opportunity to families discouraged from flying to their destination and too inconvenienced to drive.

The major policy implication from this analysis is that the government should not implement "safety" policies which will force the diversion of passengers from air to auto unless it can be demonstrated that the new policies are so effective that the additional lives saved on the air system can compensate for the higher death rate for the diverted passengers. For the case of child safety seats, this has yet to be shown.

References

Air Transport Association of America (1990), Petition to the Federal Aviation Administration, February 22, Washington.

Aviation Consumer Action Project (1985), Petition to the Federal Aviation Administration, Docket 23833, Washington.

Evans, Leonard and Michael C. Frick (1988), "Seating Position in Cars and Fatality Risk", American Journal of Public Health, Vol. 78(11), November, pp. 1456-1458.

Evans, Leonard, Michael C. Frick and Richard C. Schwing (1990), "Is It Safer To Fly Or Drive?", Risk Analysis, Vol. 10(2), pp. 239-246.

Gilmer, Nancy (1989), Letter to the Office of the Chief Council of the Federal Aviation Administration on behalf of the Association of Flight Attendants, August 8.

Lave, Lester B. (1981), The Strategy of Social Regulation, (Washington, D.C.: The Brookings Institution).

Morrison, Steven A. and Clifford Winston (1985), "An Econometric Analysis of the Demand for Intercity Passenger Transportation" in Theodore E. Keeler, ed., Research in Transportation Economics, vol. 2, (Greenwich, Conn.: JAI Press, Inc.).

United States, Department of Commerce (1989), Statistical Abstract of the United States 1989, 109th Edition, pp. 599 and 611.

United States, Federal Aviation Administration (1990), Proposal to amend several sections of the Federal Aviation Regulations, Federal Register, Part II, March 1, pp. 7414-7428.

United States, Federal Aviation Administration (1982), Denial of Petition, Regulatory Docket No. 21779, July.

United States, House of Representatives (1990), A Bill to Amend the Federal Aviation Act of 1958 to require the use of child safety restraint systems approved by the Secretary of Transportation on commercial aircraft, February 20.

AN IMPACT ANALYSIS
OF
REQUIRING CHILD SAFETY SEATS
IN
AIR TRANSPORTATION

DRAFT

Prepared for:
Operations Regulatory Analysis Branch
Office of Aviation Policy and Plans
Federal Aviation Administration

June 4, 1990

NOTICE

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. It does not necessarily reflect the FAA's position on requiring Child Safety Seats. The United States Government assumes no liability for its contents or use thereof.

Table of Contents

EXECUTIVE SUMMARY iii

I. INTRODUCTION 1

THE PROBLEM 1
THE ANALYTIC APPROACH 3

II. KEY VARIABLES USED IN THE ANALYSIS 13

FATALITY/INJURY RATES AND THE EFFECTIVENESS OF A CHILD SAFETY SEAT 13
PRICE ELASTICITY OF DEMAND FOR FAMILY AIR TRAVEL 17
SUBSTITUTIONS FOR AIR TRAVEL 19
PERCENT OF FAMILIES ELECTING TO BRING OWN CSS ON-BOARD AND PERCENT SUPPLIED BY AIRLINES 20
INFANT FARE STRUCTURE 20
PERCENT OF FAMILIES STAYING IN A HOTEL 21
TRIP DURATION (IN NIGHTS) 21

III. FINDINGS 23

FATALITIES AND INJURIES 24
CHANGES TO FAMILY COSTS AND AIRLINE REVENUES 27

IV. SENSITIVITY ANALYSIS 33

List of Appendices

APPENDIX A.	Inputs: Preliminary Estimates and Final Values Based on Expert Panel Input
APPENDIX B.	Expert Panel Members
APPENDIX C.	Model Structure and Mean Values, 1991 to 2010
APPENDIX D.	Summaries of Airline Accidents with Survivors and Infant Injuries

List of Figures

Figure 1. Decision Structure for Family Travel 5

Figure 2. Inputs to Price Sensitivity Model 7

Figure 3. Price Sensitivity and Change in Trip Demand 8

Figure 4. Price Elasticity of Demand for Family Air Travel, > 600 Miles 11

Figure 5. Monte Carlo Simulation: A Way To Combine Probabilities 12

Figure 6. Estimated Change in Fatalities and Injuries by Source of Change, 1991 . . 25

Figure 7. Net Change in Fatalities by Year, 1991-2000 26

Figure 8. Distribution of Travel Decisions Following Mandatory CSS Implementation, 1991 29

Figure 9. Net Incremental Costs to Family Travel United by Year, 1991-2000 31

Figure 10. Net Change in Airline Revenues, 1991-2000 32

List of Tables

Table 1. Infant Fatalities and Injuries in Aviation, January 1978 to April 1990 15

Table 2. Estimates of Price Elasticity of Family Demand (ϵ_D) for Air Travel 18

Table 3. Comparison of Affect of Mandatory CSS Use on Family Costs and Airline Revenues 27

Table 4. Mean Changes in Total Trip Cost To Families in 1991 28

Table 5. Impact of Infant Fare Structure on Key Outputs, 1991 33

EXECUTIVE SUMMARY

This analysis examines the consequences resulting from requiring the use of child safety seats (CSS's) on airplanes. It considers some of the choices that families may make (such as driving instead of flying to their destination) and investigates the results of these actions. It concludes that there may be a net increase in fatalities and serious injuries and there probably will be an increase in minor injuries.

About one percent of all commercial enplanements, or about four million each year, are by infants under two years of age. Today, infants can fly for free by traveling on the lap of a parent or guardian. This unsecured status means a higher risk of fatality or serious injury for unsecured infants than for infants restrained by child safety seats. This study evaluates the potential for saving lives through mandatory use of child safety seats on commercial aircraft and contrasts this with the costs of implementing such a policy. While no regulations have been issued to require child safety seats in air transportation, an active debate within the aviation community is underway concerning the advantages and disadvantages of such a rule.

The analysis examined family travel behavior under several scenarios, including short trips and long trips, hotel-based travel, and visits with relatives, and different sizes of family travel units (FTUs). The analysis is subject to a number of uncertainties concerning actions by the airlines, by traveling families, and the relative safety of airlines and automobiles. A key consideration is the degree to which the higher costs of air travel (in the event required CSS use would mean infants can no longer fly free) will encourage families to switch to automobiles, a less safe means of travel.

Because of these uncertainties, the analysis is based on a number of conservative assumptions and does not include all potential costs. For example, no estimates were included of the costs of foregone travel, of fatalities from increased local (stay-at-home) travel for diverted trips, or of the relative increase in costs attributable to a higher level of injuries from auto travel. The analysis also incorporates improved auto safety over time and bases auto fatality rates at one-half of the national average (due to the assumption that families with infants will travel primarily during the day and on rural interstates), but assumes no overall improvement in future air safety.

Fatalities and Injuries

On balance, this analysis finds that the required use of child safety seats will decrease the expected number of infant fatalities in air transportation, but increase the expected number of infant and non-infant family member fatalities as some families switch to automobiles for travel. Both changes are quite small, with a best estimate of 0.05 infant deaths prevented in the first year. The total amount of infant deaths prevented results from the decrease in deaths due to fewer infants flying because of the increased cost of air travel and the decrease in deaths from the use of CSS's, weighed against the increase in deaths because of increased auto travel. The increase in non-infant deaths is 0.95 in the first year; the increase in non-infant deaths is based on those deaths that occur from increased automobile travel less the lives saved from non-infants flying less due to the higher costs of air transportation. The net increase in fatalities of 0.90 lives in the first year.

The number of injuries that will result following CSS use, however, will increase much more significantly. Specifically, for all family travelers, net serious injuries (the difference between the change in aviation and the change in automobile injuries) are expected to increase by 4.8 and net minor injuries by 217.6, both in the first year of implementation.

Over the ten years following implementation,[1] an estimated 1.1 infant fatalities would be prevented; this is contrasted with an increase of 9.3 non-infant fatalities which results in a net increase (all family travelers) of 8.2 fatalities. Over the same period, serious injuries to all family travelers are estimated to rise by 52.0 and minor injuries (to all family travelers) by over 2,300.

The estimate of the number of preventable infant fatalities and injuries is based on an extensive review of the National Transportation Safety Board (NTSB) records coupled with interviews of NTSB personnel. The period evaluated, 1978 to present, was selected because the NTSB does not have accident investigation records readily available for accidents prior to 1978. The findings of that review indicate that, since 1978, CSS usage by infants would have prevented 1 infant fatality, 1 serious injury, and between 2 and 5 minor injuries if child safety seats had been used.

Costs

The costs of the mandatory CSS use would be high. If airlines follow current rules and sell seats for infants on the same discounted terms as used for children 2 to 12 years of age, travel costs will increase by $185 for the average traveling family or more than $250 million in the first year for all families who continue to fly; this latter figure will increase to more than $3 billion through the year 2000. In addition, the higher cost of air travel is expected to cause some 20 percent of families that would have flown to divert to other modes of travel or to not travel at all.

Airline revenues will show a net increase as families who continue to fly will have to purchase tickets for infants, but this will be partially offset by those families who switch to other travel modes or decide not to travel. Under current fare rules, and assuming that infants would be charged the same as children between the ages of 2 and

---

[1] This analysis assumes that the first year of implementation would be 1991.

12, airlines should see a net increase in revenues of about $119 million in the first year. Lower fare increases for infants, on the other hand, would divert fewer families. While airlines would earn less charging lower fares for infants, such a policy would increase the expected number of lives saved because fewer families would divert from air travel to less safe modes of travel. If, for example, fares for infants were set at one half of the average coach fare, the change in net fatalities to all family travelers would decline from the base forecast of a 0.9 increase in the first year to a lower 0.5 increase, or 4.0 net fatalities over the first ten years. Likewise, net travel costs for families would decline from $252 million in the first year to $153 million while the net change in airline revenues, while remaining positive, would drop from $119 million to $80 million.

Under current fare rules, the difference between the higher costs for families traveling and higher revenues for airlines is still quite substantial, exceeding $130 million in the status quo scenario. This figure does not include the change in traveling costs to those families that no longer elect to fly due to higher air travel costs.

I. INTRODUCTION

THE PROBLEM

Children under the age of two ("infants") account for more than four million commercial airline enplanements every year. At present, they can travel on the laps of their parents or guardian at no cost. Infants travelling in this manner, however, are not secured by any safety mechanism such as a child safety seat (CSS) or seat belt. In the event of a crash, the sudden deceleration forces are often too great for the adult or guardian to hold maintain their hold on the infant; as a result, they are at higher risk of death or injury than all other travelers who must use seat belts.

Interest in changing current practice has grown recently. The Federal Aviation Administration (FAA) has issued a Notice of Proposed Rule Making that would require airlines to permit travelers to use their own CSS if a separate seat were purchased for the infant. A key distinction in alternatives presented to date is whether or not the use of such a seat should be required rather than simply permitted. Legislation has been introduced in Congress to require CSS use, and several aviation interest groups have argued strongly in favor of such a requirement.

This study examines the estimated change in fatalities and injuries from required CSS use and the expected costs to the traveling public and the airlines. While the analysis follows the structure of a benefit-cost study, it is not a complete benefit-cost study since a dollar value is not placed on the expected benefits from reduced fatalities and no estimate is made of the cost of foregone travel.

The study is based on several key assumptions. First, because infants would have to be secured in a CSS in a separate airplane seat, the parent or guardian would have to purchase a ticket for that infant. Second, it is assumed that airlines would charge a fare for infants comparable to the fare now assessed to children between the age of 2 and 12. Third, the public's price sensitivity would be based on the change in total travel costs, which includes expected hotel, car, and incidental expenses, not just the percentage increase in family air fares.[1]

Based on these underlying economic changes, this study then estimates the change in demand for air travel, the related change in the number of fatalities for air travel (due both to the use of child safety seats and the diversion of travel away from commercial airlines), incremental costs to those continuing to fly (for both tickets and safety seats), the anticipated changes in airline revenues from families, and the expected increase in infant and non-infant fatalities due to the switch to long-distance auto travel. This study discusses, but does not attempt to quantify many qualitative factors, such as the welfare loss from families not taking planned vacations or not visiting relatives and friends.

---

[1] This implies that any measure of price sensitivity is a reflection of sensitivity to total anticipated trip costs, not just the increased fare cost.

The analysis involves a degree of uncertainty, primarily due to speculation about the likely action by airlines and the market response by families with infants. Two approaches are used to compensate for this problem. First, Economic Risk Assessment, a statistical technique that directly incorporates uncertainty into the analysis through the use of probabilities, was used to develop a model to estimate costs and change in fatalities. In this way, key inputs and outputs are presented both in terms of best estimates and in terms of probability statements -- for example, there is only a 10 percent chance that the price elasticity of demand for family air travel is below -1.4.[2]

A key part of the Economic Risk Assessment approach was the use of a panel of experts to review and comment on individual assumptions and value ranges *before* the full model was completed.[3] This process was valuable in adjusting the model structure and in incorporating the latest research and information in a field with limited published data.

Second, where possible, conservative assumptions have been used. For example, the fatality rates in automobiles have been adjusted downward to reflect recent safety trends and the greatly reduced probability of alcohol-related accidents for family travel.

---

[2] See Appendix A, page 2. This value is for shorter trip categories (less than 600 miles round-trip).

[3] Members of the expert panel are listed in Appendix B. While two staff members of the National Transportation Safety Board (NTSB) were at the panel session, they were not members of the panel. In a letter from the Director of the Bureau of Technology of the NTSB to the Regulatory Analysis Branch of the FAA on February 15, 1990, the following policy was stated with regards to NTSB employees:

> "Safety Board employees are not permitted to become members of public or government committees and panels whose deliberations may result in any type of regulatory activity. Safety Board employees are also prohibited from endorsing or approving recommendations and findings of such committees and panels."

THE ANALYTIC APPROACH

The approach used to analyze of benefits and costs is different from the traditional technique for two reasons. First, data on the number of infants flying, though reinforced by a recent industry survey, remain uncertain.[4] Second, assigning dollar values to lives remains a controversial approach to evaluating benefits, particularly when estimating that value for infants; therefore, the objective of the analysis was to identify the range of possible values for each of the variables affected, but not necessarily the dollar value for each. Thus, the results present the estimated range of incremental costs and fatalities attributable to mandatory CSS implementation, but does not attempt to compare the two.

The technique used to yield the estimated range is termed "risk assessment." Risk assessment incorporates the probability that an outcome will (or will not) materialize. This is accomplished by attaching ranges ("probability distributions") to each assumption and judgement underlying the forecast. Probabilities distributions implicitly vary all assumptions simultaneously, thus avoiding the potentially unrealistic reliance implicit in conventional sensitivity analysis on a single point estimate for any given input.

The risk analysis process for the CSS analysis involved four steps:

1) Development of Structure-and-Logic Models that define the relationship of the variables used as a basis for forecasting;

2) Assignment of point estimates and ranges (probability distributions) to each variable in the forecasting process;

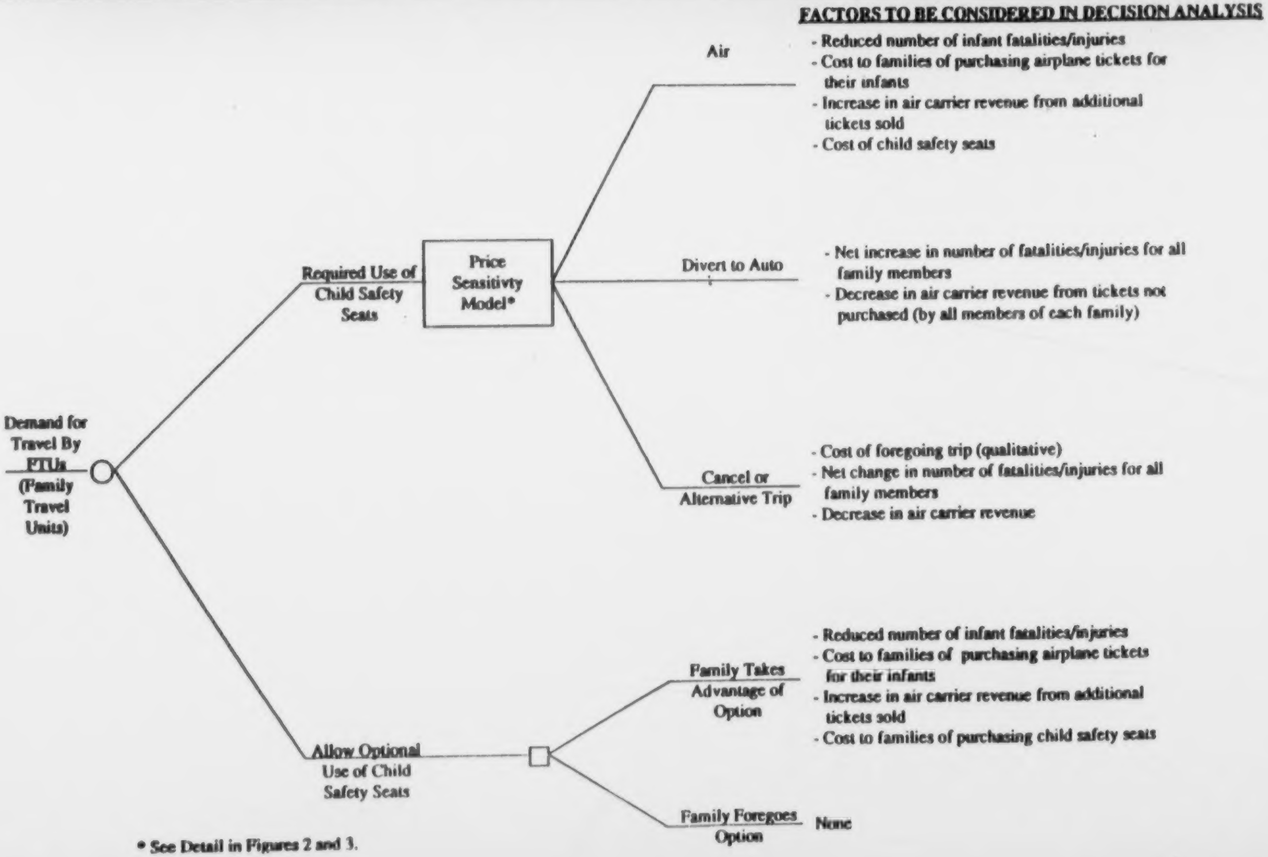
3) Review of the structure-and-logic models as well as all mean estimates and probabilities (developed in Steps 1 and 2) by an expert panel;

4) Analysis of expected benefits and costs.

---

[4] The results of that survey, prepared by the Air Transport Association, served as one of three sources for estimating the number of infants flying.

[illegible]


FACTORS TO BE CONSIDERED IN DECISION ANALYSIS
Demand for Travel By FTUs (Family Travel Units)
Required Use of Child Safety Seats
Price Sensitivty Model*
Air
- Reduced number of infant fatalities/injuries
- Cost to families of purchasing airplane tickets for their infants
- Increase in air carrier revenue from additional tickets sold
- Cost of child safety seats
Divert to Auto
- Net increase in number of fatalities/injuries for all family members
- Decrease in air carrier revenue from tickets not purchased (by all members of each family)
Cancel or Alternative Trip
- Cost of foregoing trip (qualitative)
- Net change in number of fatalities/injuries for all family members
- Decrease in air carrier revenue
Allow Optional Use of Child Safety Seats
Family Takes Advantage of Option
- Reduced number of infant fatalities/injuries
- Cost to families of purchasing airplane tickets for their infants
- Increase in air carrier revenue from additional tickets sold
- Cost to families of purchasing child safety seats
Family Foregoes Option
None

* See Detail in Figures 2 and 3.

Originally, the decision structure in Figure 1 included one additional possible decision (or branch): that of those persons electing not to fly, some might instead take a trip of some shorter distance by car or take the same trip by an alternative mode of travel. However, the expert panel, upon reviewing the data available to support this portion of the analysis, recommended that only three possible outcomes be estimated: fly, drive, or stay home. Because this will not include the risks to the FTU of travel in alternative modes, the estimate of incremental fatalities remains based on the best information available (ie., the analysis does not speculate on these diversions) and remains conservative.[6] For example, of the those who would take an alternative trip, the majority would travel by car and the remainder by either rail or bus. Not including this means that the estimate of automobile fatalities -- and, therefore, net fatalities -- will be low.

The detail and redistributive effects behind the decision point is supported by price sensitivity analysis, as depicted in Figures 2 and 3.

Inputs to Price Sensitivity Model (Figure 2)

Figure 2 depicts the relationship of two supporting data series for the cost and price sensitivity analysis: Base Population Data and Data by Demographic Segment. These series are particularly important in that they identify the population affected by the proposed required safety seat rule, which is used to predict the likely reaction to changed costs. The size and composition of the family travel unit (FTU), the distance of travel, and non-transportation trip expenses (i.e., lodging, meals, and incidentals) will all have a direct bearing on the family's decision to fly.

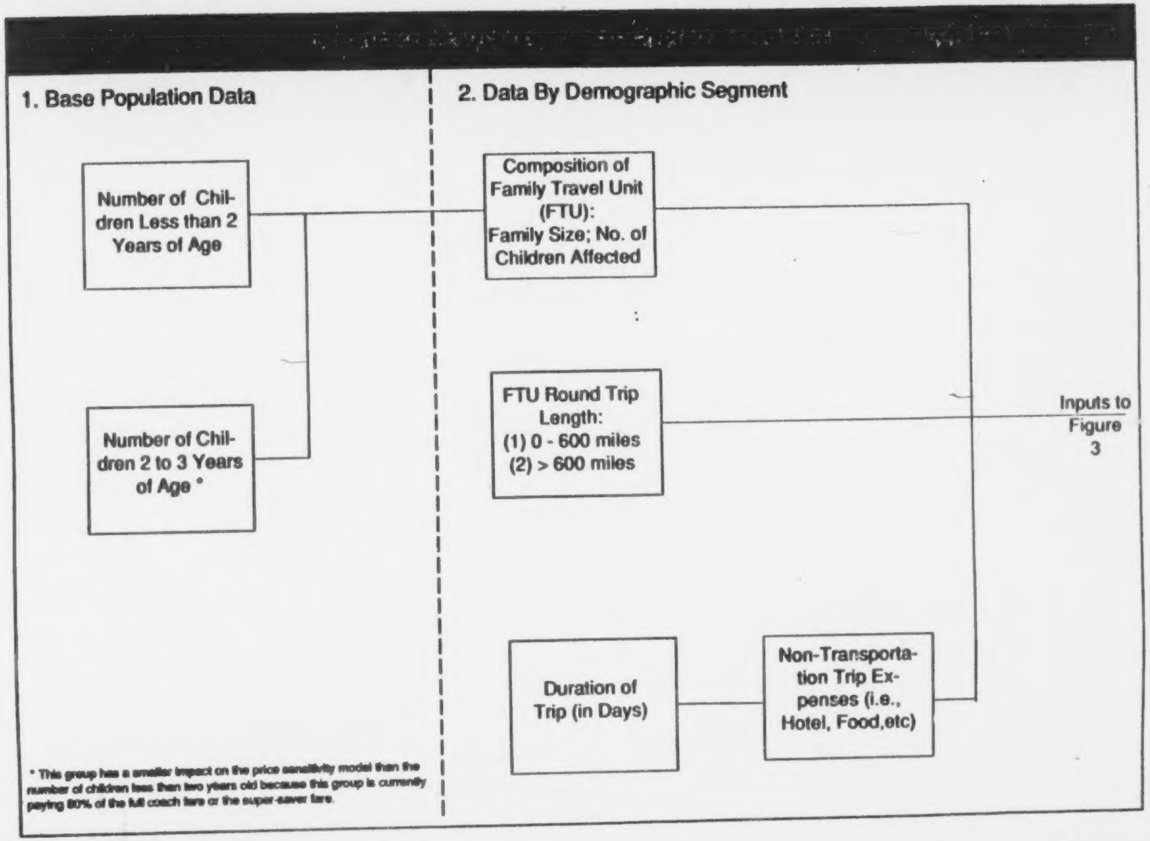
Price Sensitivity and Change in Trip Demand (Figure 3)

The variables in Figure 3 are a key part of the analysis since they include a measure for which there is some supporting data, but no specific estimate of price elasticity for family air travel. Ultimately, the purpose of this step is to understand the changed demand for airline travel based on the price elasticity.[7] The proposed regulation would require that any child who is below certain height and weight restrictions (generally, under age three) be placed in a child restraint seat which in turn, is secured to a purchased airline seat. This would increase the price of airline travel for

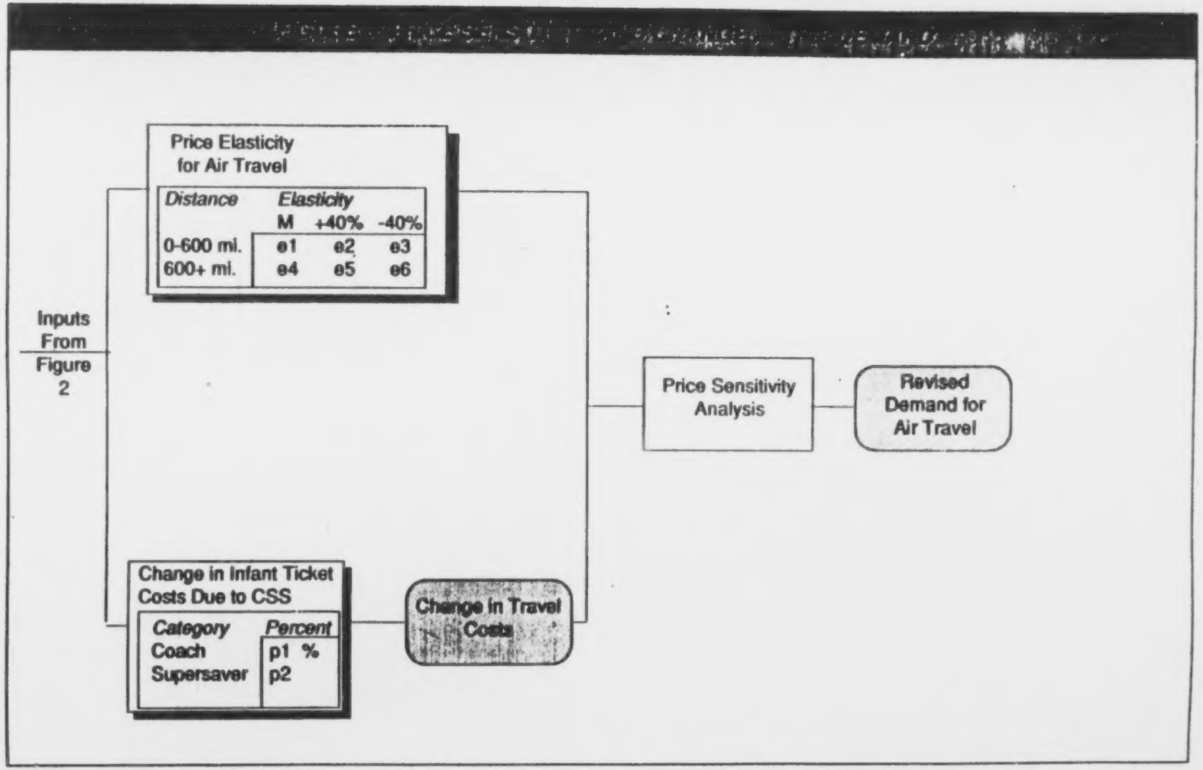
---

[6] No risk is assigned to staying home, but there is clearly an incremental change in risk for those taking alternative auto trips in lieu of flying to the original destination. Trips taken by bus or rail are considered of comparable risk to flying.

[7] The expected price elasticity of demand as measured by the airlines is distinct from the base elasticity used for this analysis since the airline measure would be based solely on changes in fare cost.


1. Base Population Data
2. Data By Demographic Segment
Number of Children Less than 2 Years of Age
Number of Children 2 to 3 Years of Age *
Composition of Family Travel Unit (FTU): Family Size; No. of Children Affected
FTU Round Trip Length: (1) 0 - 600 miles (2) > 600 miles
Duration of Trip (in Days)
Non-Transportation Trip Expenses (i.e., Hotel, Food,etc)
Inputs to Figure 3

* This group has a smaller impact on the price sensitivity model than the number of children less than two years old because this group is currently paying 80% of the full coach fare or the super-saver fare.


Price Elasticity
for Air Travel
Distance
Elasticity
M
+40%
-40%
0-600 mi.
e1
e2
e3
600+ mi.
e4
e5
e6
Inputs
From
Figure
2
Change in Infant Ticket
Costs Due to CSS
Category
Percent
Coach
p1 %
Supersaver
p2
Change in Travel
Costs
Price Sensitivity
Analysis
Revised
Demand for
Air Travel

2 SIDED COPY

families with children under age two because the parents would have to purchase seats for their children under 2 years of age.

In addition, this graphic includes another variable whose value is difficult to predict: the cost of air travel to an infant. Since commercial airline policy generally allow children between 2 and 12 to fly for the lesser of 80 percent of the coach fare or the supersaver rate, this analysis assumes that this policy will be carried forward to infants. Because of the importance of this variable to the results, however, Section IV will describe the potential impact on demand and fatalities; this section follows the presentation of the overall results.

STEP 2. ESTIMATES AND PROBABILITY DISTRIBUTIONS

Each variable identified in the CSS model must be assigned a numerical estimate and a range that represents the degree of uncertainty. Thus, the first phase of Step 2 was to develop a series of data sheets with preliminary distribution estimates to be evaluated by expert panel members. For analysis, the range used in discussions represented "an 80 percent confidence interval" -- or that there is only a 10 percent chance that the actual value will be above the range and a 10 percent chance that the it will fall below the range. In short, the more uncertain about an assumption, the wider the range will be, and vice versa. This process ensures that all risks are properly reflected in the forecasting process.

The preliminary estimates were forwarded to expert panel members in advance of the expert session for review.[8] Appendix A presents a detailed listing of each of the variables considered in the analysis and the values that were ultimately agreed on in the expert panel session.

STEP 3. EXPERT PANEL SCRUTINY

To ensure that the study is based on realistic assumptions and that the probability distributions for each of the model variables were as accurate as possible, experts were invited to critique the analytic process and preliminary inputs developed in Steps 1 and 2. Safety and airline industry experts were asked to participate in the process of reviewing the assumptions and shaping the probabilities associated with forecast accuracy.[9]

---

[8] Panelists were notified of the estimates for which no data currently exists, such as the potential rate of diversion to automobile travel for each of the trip distance categories.

[9] See Appendix B for a list of expert panel participants.

After reviewing supporting data and discussing the preliminary input estimates, the panelists discussed appropriate values for each variable. The model was revised based on this discussion. Both the original set of estimates and the new values are presented in Appendix A, with the former set shown on pages A-1, A-3, A-5, A-7, and A-9, and the corresponding latter set following on pages A-2, A-4, A-6, A-8, and A-10.

STEP 4. MODEL EXECUTION AND RESULTS

Once the data sheets were finalized, the ranges for each variable were transformed into statistical probability distributions. Figure 4 presents the simulated range of values for one of these variables, price elasticity of demand for family air travel, trips greater than 600 miles. As illustrated in Figure 5, these distributions can then be combined using a technique that simulates real-world uncertainty by allowing all assumptions to vary from their expected values within predefined limits, Monte Carlo Simulation (See Box, right). The result is a forecast of the distribution of decision outcomes (fly, drive, no trip/other) and the range of benefits and costs associated with those decisions.

Monte Carlo Simulation

One objective of the analysis was to determine the risk, or probabilities, associated with each forecast outcome. To achieve this, *Monte Carlo simulation* was used. Monte Carlo simulation requires two additional steps in the development and execution of the computer model. First, the input values have to be stated in terms of probability distributions rather than expected values. In this analysis, these values were developed first through the preliminary estimates developed by Apogee Research (Task 2) based on historical evidence (where possible) and second through the expert panel review (Task 3), where initial values were subsequently refined. Appendix A details the values selected.

Second, the computer model must randomly sample from the stated probability distributions for input to the equations developed as part of Task 1. Sampling is done repetitively, with each iteration resulting in a different outcome. Over the course of a large number of iterations (this analysis relied on 1,000 iterations), probability distributions are generated for each of the model inputs and, as a result, probabilities are calculated for each of the model outputs.

FIGURE 4.
PRICE ELASTICITY OF DEMAND FOR FAMILY TRAVEL, >600 MILES

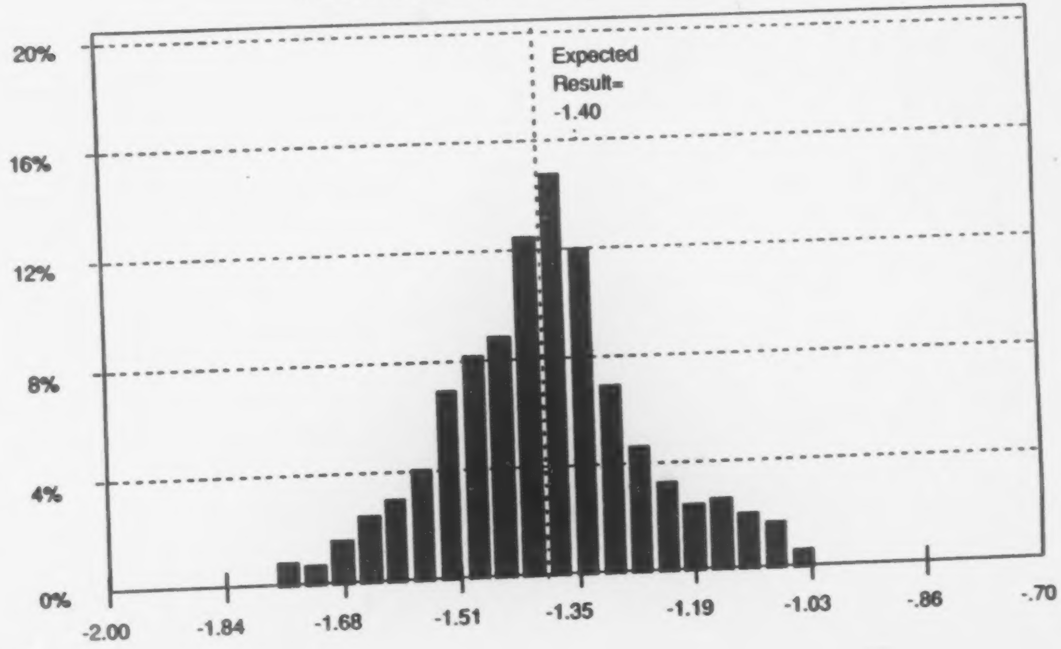
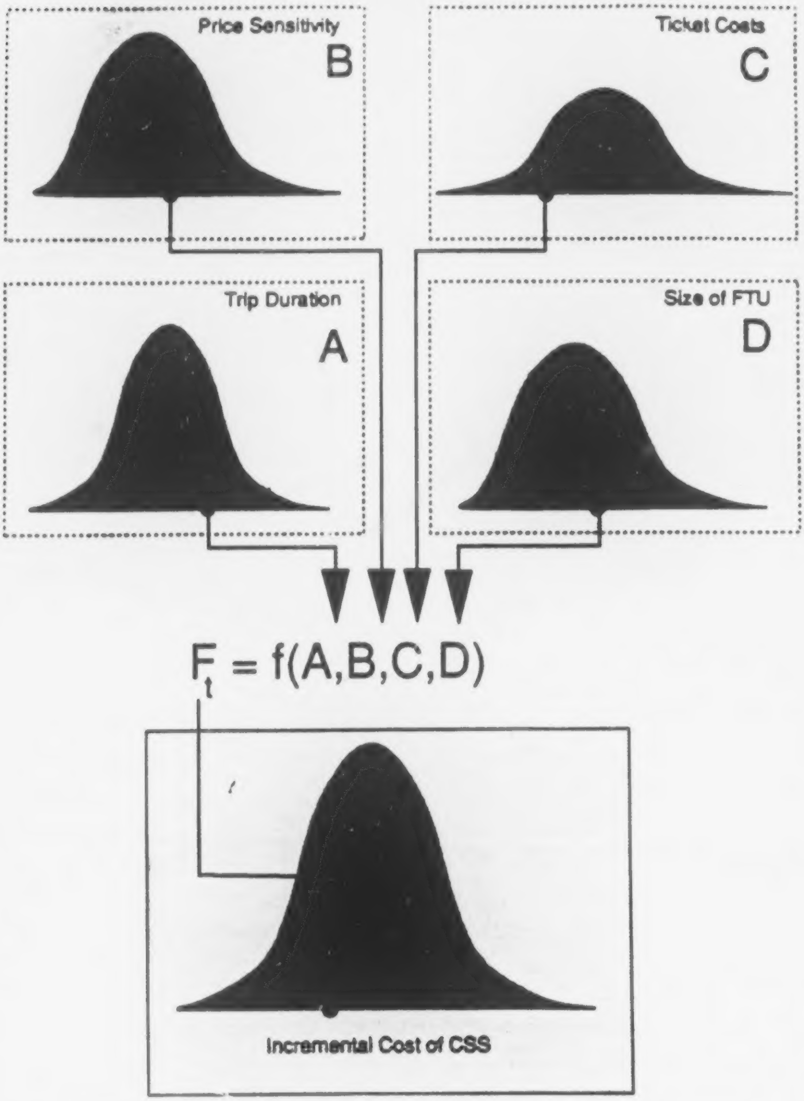


FIGURE 5. MONTE CARLO SIMULATION: A WAY TO COMBINE PROBABILITIES


Price Sensitivity
B
Ticket Costs
C
Trip Duration
A
Size of FTU
D
$F_t = f(A,B,C,D)$
Incremental Cost of CSS

Note: This chart is a simplified depiction of the actual model. Appendix C presents more detail.

II. KEY VARIABLES USED IN THE ANALYSIS

This section describes the key variables for the analysis of CSS benefits and costs. Each description includes a definition of the variable, how it was used in the analysis, the reasoning behind the selected values, and the values themselves. Details on the probability ranges surrounding each of the values used are presented in Appendix A.

FATALITY/INJURY RATES AND THE EFFECTIVENESS OF A CHILD SAFETY SEAT

Fatality and injury rates for aviation and automobile travel are based on historical accident data from the National Highway Traffic Safety Administration (NHTSA) and the National Transportation Safety Board (NTSB). This section describes the supporting information and the rates selected for non-infant family members and infants.

Non-Infant Family Members

Automobile passenger fatality rates were adjusted downward from the 10-year system average of 0.887 passenger deaths per 100 million passenger miles to 0.414 because families generally travel during the day (therefore being exposed to fewer alcohol related incidents) and on rural interstates highways (where fatality rates per passenger mile are lower). This adjusted fatality rate, agreed on in the expert panel session, also resulted in a conservative (lower) estimate of the number of fatalities attributable to automobile travel.

Automobile injury data were derived from a NHTSA survey. NHTSA annually surveys police accident reports, selecting a sample of between 10,000 and 15,000. The data used to support this analysis were based on a compilation of survey results for the period 1983 to 1986.[10] The findings are presented in two categories: (1) fatal and serious injuries and (2) minor injuries. Taken together with the actual number of fatalities and non-fatal injuries reported by the U.S. Department of Transportation,[11] it was possible to calculate the relative risk of serious and minor injury.

---

[10] The NHTSA did not undertake the survey in 1987 and changed the survey approach in 1988. The 1988 data were not considered comparable.

[11] Presented in *Highway Statistics*, U.S. Department of Transportation, "Motor Vehicle Traffic Fatalities and Injuries", various years.

Aviation fatality and injury rates were calculated based on NTSB reported fatalities and injuries for U.S. certificated air carriers over a 9-year period (1980 to 1988),[12] and the total passenger miles flown for that period.[13] Unlike automobile travel where published risks were lowered to reflect the lower risks of family auto travel, risks of family air travel were not decreased since air passengers are grouped at random and families are exposed to the same risk as all passengers.

Infants

The base rate for non-infant automobile fatalities (0.414) was further revised downward to account for the additional safety of the recent use of child safety seat (CSS), based on an analysis prepared by the National Highway Traffic Safety Administration.[14] That analysis indicates that infant fatalities were reduced by 47 percent in automobile accidents with the introduction of CSSs. Because CSSs are now required in all states for automobile travel, the base fatality rate was reduced by 47 percent (or to 53 percent of its original level) to 0.219 per 100 million infant passenger miles).

The data to support a forecast of *preventable* infant fatalities and injuries in aviation were not available at the start of this analysis. Therefore, all NTSB aviation accident investigation reports were reviewed since 1978 for crashes and accidents with survivors.[15] While it is not required that NTSB investigators report infant injuries and fatalities separately, it has been the NTSB's practice to do so. This review included analysis of the seating location, damage to the aircraft, and the types and extent of injuries sustained. In addition, an NTSB human survivabilities factor investigator was interviewed for those cases where the evidence did not support a conclusion.[16]

The findings from the detailed review of each accident account, summarized in Table 1, below, indicate that fewer infant lives could be saved with the use of child safety

---

[12] The NTSB classifies injuries as either "serious" or "minor".

[13] Total passenger miles was based on data presented in *FAA Aviation Forecasts*, various years.

[14] *Effect of Child Occupant Protection Laws on Fatalities*, U.S. Department of Transportation, National Highway Traffic Safety Administration technical report, DOT HS 807 453, (August 1989).

[15] This amounted to 318 individual accidents involving U.S. Certificated Air Carriers over the 12-year period.

[16] For a detailed description of the findings for each accident evaluated, see Appendix D, Summaries of Airline Accidents with Survivors and Infant Injuries.

Table 1.
Infant Fatalities and Injuries in Aviation, January 1978 to April 1990

Date of Accident	Fatalities		Serious Injuries		Minor Injuries	
	Total	Preventable	Total	Preventable	Total	Preventable
05/08/78	0	0	0	0	1	0
08/13/78	0	0	0	0	1	0
12/04/78	0	0	0	0	1	0
12/28/78	2-3[*]	0	0	0	2	0-2
04/14/79	0	0	0	0	1	0
01/13/82	3	0	0	0	0	0
07/21/84	0	0	1	0	0	0
05/28/85	0	0	0	0	1	1
08/02/85	1	0	0	0	0	0
07/13/86	0	0	0	0	1	1
10/25/86	0	0	0	0	1	0-1
11/15/87	1	0	0	0	0	0
12/23/87	1	0	0	0	0	0
08/31/88	0	0	0	0	2	0
07/19/89	1	1	0	0	3	0
01/20/90	0	0	1	1	0	0
TOTAL	9-10	1	2	1	14	2-5

[*] The exact age of the third fatally injured child is unknown.

seats than had originally been anticipated. An earlier study of lap children fatalities in survivable airplane accidents suggested that approximately 3 of the 5 infant fatalities for the period surveyed were preventable.[17] Extrapolating these results to the actual number of infant fatalities in airplane accidents with survivors over the period January 1978 to April 1990, there should have been 5 or 6 preventable fatalities. However, on closer examination, the detailed review of accident reports revealed only one preventable fatality over this period, that of the 1989 United Airlines crash in Sioux City, Iowa.

Three reasons account for this discrepancy. First, the Fife, *et al*, study relied on accident data over a shorter period of time (the four years 1976 through 1979) and did not seek to identify the rate of preventable infant fatalities. Its objective was instead to estimate the risk of mortality for unbelted infants relative to all other passengers.

Second, three of the five infant fatalities were identified as unpreventable by a National Transportation Safety Board review at the time of the accident:

> *"The two fatally injured infants and the child probably would not have survived the accident regardless of means of restraint because they were located in the destroyed section of the aircraft."*[18]

Third, a detailed review of the NTSB accident investigation report leads to the conclusion that the fatalities were, as best can be estimated, unavoidable.

The NTSB records review included identification and classification of all injuries (serious and minor) to infants and whether they could have been prevented through CSS use (see Table 1, above). The estimate of the number of preventable infant fatalities was based on the period 1978 to the present. This period was selected because the NTSB does not have accident investigation records readily available for accidents prior to 1978. Therefore, the estimated number of preventable infant fatalities and injuries do not coincide with either the Fife, *et al*, study or the Federal Aviation Administration's Notice of Proposed Rulemaking, both of which relied on data for periods prior to 1978.

Thus, as can be seen in Table 1, the findings of the review of NTSB records indicate that, since 1978, CSS usage by infants would have prevented 1 infant fatality, 1 serious injury, and between 2 and 5 minor injuries in aviation accidents involving U.S. air carriers. Foreign air carriers are not subject to FAA regulations and, thus, foreign air carrier accidents are not considered in this analysis.

---

[17] Fife, Daniel, *et al*, "Relative Mortality of Unbelted Infant Passengers and Belted Non-Infant Passengers in Air Accidents With Survivors", *American Journal of Public Health*, Volume 71, No. 11, pp. 1242-1246, (November 1981).

[18] From National Transportation Safety Board "Safety Recommendation A-79-62 through 66", submitted to the Administrator of the Federal Aviation Administration, p. 2 (August 24, 1979).

Values Selected

The forecast number of fatalities for non-infant family members in both aviation and automobile were based on the rate per 100 million passenger miles, described above. However, unlike the forecast of non-infant fatalities, an annual number of preventable infant fatalities was used. This number was inflated by the forecast rate of growth in infant enplanements.

CSS use for automobiles were assumed to be 50 percent effective. This value, agreed on by the expert panelists, is slightly higher than the actual average to reflect the range of ages for infants using a CSS. No comparable number was necessary for aviation since the NTSB record review provided an estimate of the expected number of preventable infant fatalities.

The ratio of injury type to fatalities was applied to the estimated net change in fatalities for each category of family passenger to forecast serious and minor injuries. The ratios for non-infant injuries were derived from NHTSA data. The ratios for infant injuries were based on the NTSB records review.

PRICE ELASTICITY OF DEMAND FOR FAMILY AIR TRAVEL

Price elasticity of demand for family air travel accounts for the effects a price increase on the demand for family air travel and is expressed as the percentage change in demand for each one percent change in price. The price increase for a family is the additional cost of providing an airline seat and a child safety seat (if needed) for the family's children under age two. For example, a price elasticity of -1.5 means that a one percent increase in price will result in a 1.5 percent decrease in demand. Two factors were expected to influence a family's response to mandatory CSS use: distance of travel and the composition/size of the family travel unit. In addition, the trip duration and percent of families staying in hotels while on travel were considered influences but are described in separate sections below.

Distance influences the price responsiveness of families with small children. A family flying across the U.S. will be less likely to cancel air reservations given a certain percentage increase in total family travel cost, than will a family flying from New York to Boston. Fewer viable alternative forms of transportation exist for the family traveling further, particularly considering they are traveling with small children. Thus, one might expect families traveling longer distances to be less price elastic (smaller elasticity number in absolute value) and families traveling shorter distances to be more price elastic (larger elasticity number in absolute value).

The composition of a family travel unit will also affect the family's response to the price increase. For instance, a family of five and a second family of three each flying across the country with a child under age two will most likely differ in their response to the increase in family travel costs. The additional cost of 80 to 100 percent of an adult fare for their child may seem less burdensome for the larger family in order to avoid a prolonged automobile trip across the country. However, the smaller family has only one child and therefore, the price increase may induce them to drive the distance since one child might be manageable for a long trip. The family size effect would tend to make larger families less price elastic (smaller elasticity number in absolute value) and smaller families more price elastic (larger elasticity number in absolute value).

The price elasticity was used to estimate the number of families diverted from air travel as a result of requiring CSS on airplanes for infants. The estimate of price elasticity for family travel units (FTUs) was based on those FTUs travelling with either one or two infants (a decision based on data supporting analysis of the proportion of trips by size).

Trips were divided into short distance (under 600 miles round-trip) and long distance (over 600 miles round-trip). The round-trip distance of 600 miles was chosen as the division, since a one-way, 300-mile trip was believed to be the maximum one-day travel auto distance for families with small children.

The estimate developed prior to expert panel review for the average price elasticity for family travel demand was based upon the evidence presented in Table 2, below. Based on these estimates, the price elasticity for family air travel likely falls between -1.0 and -2.0, or an average of approximately -1.5.

Table 2.
Estimates of Price Elasticity
of Family Demand (ϵ_D) for Air Travel

Estimate of ϵ_D for Family Air Travel	Source	Characteristics
-1.2	Norfolk to Florida Cities (Apogee)	All passengers, domestic, likely majority of vacation travel
-0.82	FAA	All passengers, domestic flights
-0.5	Minneapolis/St. Paul Study (Apogee)	All passengers, domestic, likely majority of business travel
0.0	Transport Canada (est.)	Business travel
-2.0	Transport Canada (est.)	Personal travel

Values Selected

Panelists concluded that appropriate measures for FTUs travelling less than 600 miles round-trip would be relatively price sensitive at -1.9. Longer trips in the category 600 miles and greater would necessarily be less elastic due to the lack of viable alternative modes of travel and likely higher trip costs overall. Consequently, this elasticity was estimated at -1.4.

SUBSTITUTIONS FOR AIR TRAVEL

The model calculates the likely diversion to an alternative travel plan which is based on the family elasticity of demand. Families no longer flying have a number of alternatives available to them including: traveling to their intended destination by car, staying at home, or taking a trip by some alternative mode of transportation. As discussed in the presentation of the logic diagrams, the third option was not evaluated due to its inherent uncertainty.

Trips were again divided into short distance (under 600 miles round-trip) and long distance (over 600 miles round-trip). As above, the round-trip distance of 600 miles was chosen as the division, since this distance was believed to be the maximum one day auto travel distance (by auto) for families with small children.

It was assumed that the primary factors influencing the allocation of family units across alternatives to air travel are distance and family unit composition. As the travel distance grows, families are less willing to drive the original trip and more willing to take an alternate/shorter trip. Family reactions to staying at home are assumed not to differ whether the original trip was long or short distance.

Values Selected

Two values were selected. Of the FTUs no longer flying that would have flown the shorter distance (less than 600 miles), 70 percent would now drive. Likewise, of the FTUs that would have taken the longer trip by air but are not now, only 20 percent will drive.

It should be noted that since no empirical studies on alternatives to family air travel were available to estimate these values, actual responses were expected to vary widely from the responses estimated above. Consequently, probability distributions attached to these values were made wide.

PERCENT OF FAMILIES ELECTING TO BRING OWN CSS ON-BOARD AND PERCENT SUPPLIED BY AIRLINES

Rulemaking in any form with respect to child safety seats (CSSs) is generally expected to allow parents (or other members of the FTU) to carry their own CSS on the aircraft. This variable reflects the number of individual electing to do so in lieu of using a CSS supplied by the airline.

This variable would reduce the number of CSS purchases required by the airlines to accommodate any new rules, thus reducing the estimated cost. The remainder of this value subtracted from 100 represents the percent of CSSs to be supplied by airlines (e.g., if 95 percent of FTUs will bring their own CSS on board, 100 minus 95, or 5, percent of all demand for CSSs will have to be met by the airlines).

Values Selected

It appears likely that the majority of families flying (regardless of distance) will elect to bring their own CSS with them in order to have it available over the course of the trip. (Particularly since they are now required for auto travel by state law in all states.) Some will not for a variety of reasons, convenience among them. Therefore, the baseline value for this variable was assumed to be high -- 95 percent -- and the range relatively small.

INFANT FARE STRUCTURE

The average infant ticket price, expressed as a percent of the regular coach price, will be used in the model to determine the additional fare cost for each infant under the age of two. Currently, an infant under the age of two is allowed to travel on the lap of an accompanying adult for free. Since this would no longer be the case if a CSS were required, the price structure for children between the ages of 2 and 12 is used as a proxy for the new fare rate. Generally, children between the ages of two and twelve are charged for the seat at either 80 percent of the regular adult coach fare or the supersaver fare, whichever is less.

Depending upon a number of variables (e.g., number of members of the family travel unit, duration of the trip, and additional trip expenses), infant fares can add significantly to the total trip costs. As noted in the discussion of the model structure, any increase in the total fare cost per family travel unit directly affects the family's decision whether to travel by air, to travel by automobile to avoid the increased fare, or whether to travel at all.

Values Selected

The baseline assumption was that fares for infants under the age of two will be 80 percent of the regular adult coach fare or the supersaver fare (assumed to be 50 percent of regular coach), whichever is less.

PERCENT OF FAMILIES STAYING IN A HOTEL

This variable is the percentage of all family travel that involves a hotel stay. The percent would be used to reflect the higher cost associated with travelling, and, therefore, reduced effect of higher airline costs. For example, a family on travel that elects to stay in a hotel would be less sensitive to changes in the air fare since, as a fraction of total trip costs, it would be smaller than that of a family staying with relatives. On longer trips, hotel costs contribute a significant amount to the total trip cost--as much as 50 to 75 percent.

Values Selected

Based on data from the U.S. Travel Data Center, 43 percent of family travel involves a hotel stay.[19] This value was selected for round-trip travel less that 600 miles. Because of the lower cost relative to total travel costs, the expert panelists generally agreed that the percent staying in hotels on trips of longer distances will be a slightly higher (53 percent) for distances greater that 600 miles. Based on the size of the sample from which the base assumption is drawn, the range for these estimates is relatively high (an absolute value of plus or minus 10 percent).

TRIP DURATION (IN NIGHTS)

Trip duration is used to forecast non-air fare travel expenses, including hotel costs, meals, ground transportation (only applicable for air travellers), and miscellaneous expenses for the purposes of evaluating price sensitivity. The number is expressed in nights to capture all potential hotel costs. The source of data for the estimates of trip duration used in the analysis was the U.S. Travel Data Center.

---

[19] This estimate was revised upward after cross-tabulations of U.S. Travel Data Center data was made available for air travel alone.

Values Selected

Based on data from the U.S. Travel Data Center, the duration of a typical non-business trip is slightly over seven nights. Based on expert panel discussion, there is also some justification for a divergence in duration according to the distance of the trip. Consequently, the estimates reflect an extended duration for longer distance trips of 10 nights. The upper and lower bounds used for the probability distributions of these estimates reflect the wide range of travel duration and the possibility of two periods of travel, 3 days and 7 to 10 days.

III. FINDINGS

Required child safety seat (CSS) use by the FAA is estimated to result in:

- An slight increase in the number of net fatalities to all family travellers affected (0.9 more in the first year);
- An increase in the number of serious and minor injuries to all family travellers affected (4.8 and 217.6 in the first year, respectively);
- Considerable additional costs to families still interested in travelling by air; and
- A net increase in passenger revenues to airlines.[20]

In addition to these quantitative measures, the changed procedures and costs of CSS use would incur many qualitative costs. For example, many families that would have elected to travel by air before mandatory CSS use will now either have to seek alternative transportation or forego the trip altogether. In addition, even for those families that still have the option to travel by some other mode of travel (expected to be primarily automobile), travel time would, on average, be increased considerably. The implied lost opportunities in these factors represent a large unquantified cost of requiring CSSs. While this report does not attempt to quantify these costs. The costs quantified for changes resulting from required CSSs are discussed in four sections:

- Fatalities and Injuries,
- Costs of air travel to families,
- Revenues to the airlines, and
- Comparison of changes in costs and revenues to airlines and families.

Because risk assessment was employed in the analysis, all results can be presented in a probabilistic fashion that reflects the range and probabilities of each of the inputs to the analysis. For each graph where a range of values is presented, there is a two-thirds

---

[20] These estimates are based on the mean value (50 percent probability) derived from this analysis.

(68 percent) chance that the actual value will fall within the shaded area and a 95 percent chance it will fall within the lines outside of the shaded area. The expected (mean) value is identified by the dark line in the middle of the range.

FATALITIES AND INJURIES

At first look, increases in fatalities and injuries appear counter-intuitive. Why would fatalities and injuries increase? The answer is that many families who would have flown will now elect to travel by automobile -- a riskier mode of travel -- because of the increased cost of travelling by air.

For each of the three physical injury categories (fatal, serious, and minor), this analysis considered the impacts on estimates of three changes: a reduced risk to infants, decreased demand in aviation due to higher ticket costs, and increased demand for automobile travel. Each of these was calculated for infant and non-infant family members. Figure 6 presents the findings for each category of traveller and injury in the first year of mandatory CSS use (here assumed to be 1991).

There is a small improvement in safety, for infants that fly; there will be 0.1 fewer infant deaths per year on average. However, because flying would cost more under a mandatory CSS scenario, more families would elect to drive (thereby travelling by a less safe mode of travel) than do now. There is a further reduction in infant fatalities in aviation due to the decreased demand for air travel which is estimated to be 3 times higher than that directly attributable to the use of CSS (0.3 fewer fatalities per year attributable to lower demand for air travel versus 0.1 attributable to CSS use in the first year of implementation). This second reduction in infant fatalities is almost exactly offset by the loss of infant lives in automobile travel (0.3 in the first year).

Non-infant family members are expected to experience a slight increase in the number of fatalities (0.9 in the first year). As was the case for infants, there will be a reduction in aviation fatalities attributable to reduced demand, but there will be an even larger number of fatalities due to increased demand for automobile travel.

In addition to forecasts of the expected value of fatalities, the risk assessment technique employed for this analysis allows presentation of the findings in a probabilistic framework. Figure 7 depicts the range of forecast fatalities for each of the first ten years following CSS requirement in that manner.

FIGURE 6.
ESTIMATED CHANGE IN FATALITIES AND INJURIES BY SOURCE, 1991[a]
(BY FAMILY PASSENGER TYPE)

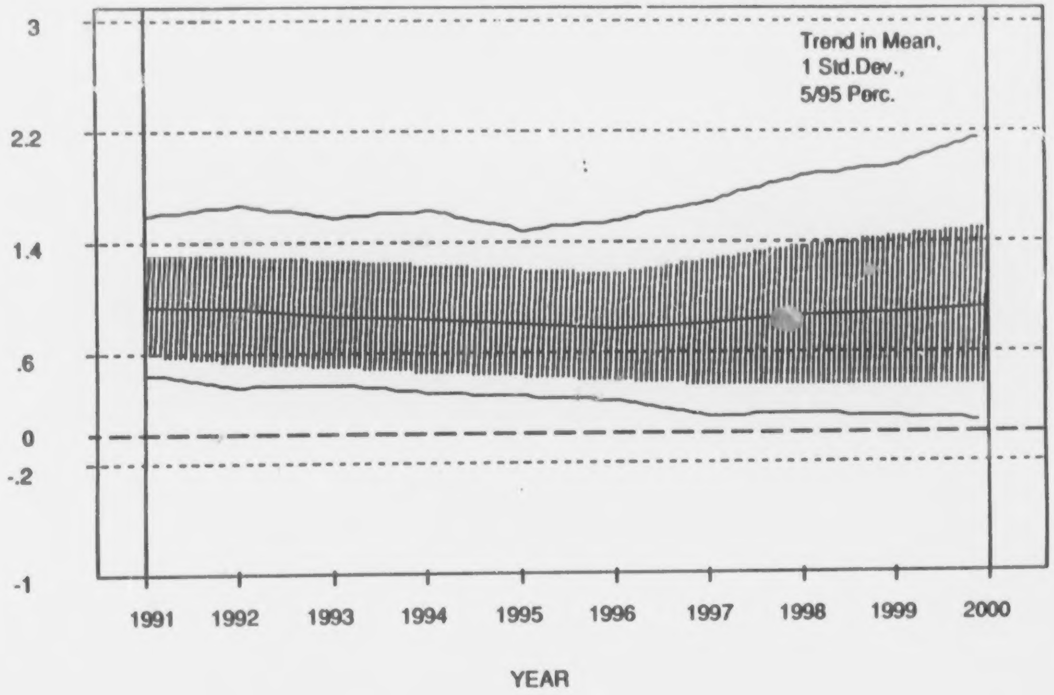
	FAMILY PASSENGER TYPE	REASON FOR CHANGE	CHANGE	NET CHANGE[b]
FATALITIES	INFANT	AVIATION–DECREASED DEMAND	-0.3	-0.05
		AVIATION–W/ CHILD SAFETY SEAT	-0.1	
		DIVERTED TO AUTOMOBILE [c]	0.3	
	NON-INFANT	AVIATION–DECREASED DEMAND	-0.8	0.95
		DIVERTED TO AUTOMOBILE	1.7	
				0.90
SERIOUS INJURIES	INFANT	AVIATION–DECREASED DEMAND	-0.3	0.47
		AVIATION–W/ CHILD SAFETY SEAT	-0.1	
		DIVERTED TO AUTOMOBILE [c]	0.8	
	NON-INFANT	AVIATION–DECREASED DEMAND	-0.2	4.34
		DIVERTED TO AUTOMOBILE	4.6	
				4.81
MINOR INJURIES	INFANT	AVIATION–DECREASED DEMAND	-1.0	32.70
		AVIATION–W/ CHILD SAFETY SEAT	-0.3	
		DIVERTED TO AUTOMOBILE [c]	34.0	
	NON-INFANT	AVIATION–DECREASED DEMAND	-0.6	184.85
		DIVERTED TO AUTOMOBILE	185.4	
				217.55

[a] OR FIRST YEAR OF IMPLEMENTATION

[b] NEGATIVE NUMBERS ARE DECREASES IN THE NUMBER OF FATALITIES, SERIOUS, OR MINOR INJURIES AND POSITIVE NUMBERS ARE INCREASES.

[c] ALL INFANTS TRAVELLING BY AUTOMOBILE ARE ASSUMED TO USE A CHILD SAFETY SEAT.

FIGURE 7.
NET CHANGE IN FATALITIES BY YEAR,
1991-2000



Injuries

As was the case for the estimate of fatalities, new automobile traffic resulting from diverted flyers will expose family member to a higher level of risk of injury.[21] However, unlike the estimated number of fatalities which were relatively small, the forecast number of injuries begins to fall in the statistically significant range, with serious injuries increasing by 4.8 and minor injuries up by 217.6, both in the first year of implementation.

CHANGES TO FAMILY COSTS AND AIRLINE REVENUES

Table 3, below summarizes the relationship of the change in family travel costs (not including the cost of the CSS itself) to the change in airline revenues. In short, fewer families will continue to fly and pay the higher cost of flying. Airlines, though losing revenues from those families no longer flying, will actually earn more because the increased cost of travel from those families with infants that continue to fly.

Table 3.
Comparison of Affect of Mandatory CSS Use on Family Costs and Airline Revenues

Cost/Revenue Factor	Current Policy	Mandatory CSS Use*	Change/Notes
Ticket Cost:			
for Non-Infant Family Members	$1,075	$948	The cost of travel to this group drops because of lower demand. (Ticket price does not change.) The change will be offset by lost travel opportunities for those families that elect not to travel and by increased auto travel costs. These changes were not quantified.
for Infants	0	246	$246 million. This is the incremental cost to families that still fly.
Airline Revenues	$1,075	$1,194	$119 million. Airlines lose revenues from lower non-infant travel demand. However, that loss is more than offset by infant passenger ticket revenues.

* These costs do not include CSS purchase cost ($5 million in the first year).

---

[21] The one factor that distinguishes the forecast of fatalities from the forecast of injuries is that the number of infant air travel injuries that were forecast as preventable was adjusted upward from the system average to reflect the findings of the NTSB accident investigation report review.

The Cost of Air Travel to Families

The most important cost impact of mandatory CSS usage is that tickets must now be purchased for infants. In addition, some families are expected to have to purchase a CSS for aircraft use.[22] Those additional costs are expected to change travel plans for large numbers of families. Table 4 (below) shows why. Based on the price elasticity estimates for both long and short trips, the additional ticket cost will result in significant increases in total trip costs (10.3 percent on average).

Table 4.
Mean Changes in TOTAL Trip Cost
To Families in 1991

Travel Distance (Round Trip)	Change in Trip Cost (in percent)
0 to 600 Miles	15.1%
600+ Miles	9.9
Weighted Average	10.3%

The practical implications of diversions are that some families will now have to change their plans. In 1991, based on the estimated change in total travel costs and the price elasticities discussed in Chapter II, nearly 80 percent of all families that would have flown before mandatory CSS use will continue to fly to their destination in 1991, 5 percent will drive, and 15 percent will not take the trip at all (see Figure 8, below).

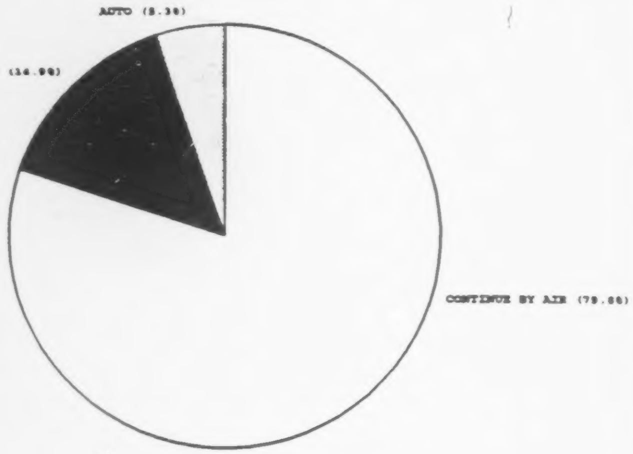
The average family that elects to travel will have to bear the cost of an additional ticket. This amounts to an average fare increase of approximately 31 percent per family, or, for those families travelling without the benefit of frequent flier bonuses or similar cost reductions, an average increase of between $181 and $201 per family.[23] The child

---

[22] Because airlines feel that maintenance, cleaning, and general management of a stock of CSSs would be time-consuming and expensive, they are expect to sell a low-cost CSS specifically designed for use on aircraft (rather than provide one). At the time of this analysis, the best estimate for the cost of such a device was $20. See also Section II, page 18.

[23] The range reflects the cost to some of a CSS. Airlines are currently developing models that would be sold at the gate for an estimated $20 per unit. It is expected that 20 percent of families would have to purchase seats for a three-year transition period, and an average of 5 percent thereafter.

Figure 8. Distribution of Travel Decisions Following Mandatory CSS Implementation, 1991



safety seat will also increase costs to some families. Figure 9 presents the expected range of incremental costs to families travelling for the first 10 years following required CSS use. To use conservative cost values, it was estimated that 20 percent of families will have to purchase CSS for the first three years and 5 percent thereafter. This represents a comparatively small incremental cost (on average) to travellers relative to the additional ticket cost (an average of less than 2 percent of total incremental FTU costs for the transition and less than one percent thereafter).

This study makes no attempt to quantify the costs of taking an automobile trip in lieu of flying, since this would require an estimate of the value of travel time for each family on a comparative basis (flying versus driving), together with some estimate of the utility received from the time savings associated with flying. Instead, this study identifies the shift in demand predicted and the direct quantifiable costs associated with that change. In this way, the study presents a conservative estimate of the actual cost of mandatory CSS use.

FIGURE 9.
NET INCREMENTAL COSTS TO
FAMILY TRAVEL UNITS BY YEAR, 1991-2000

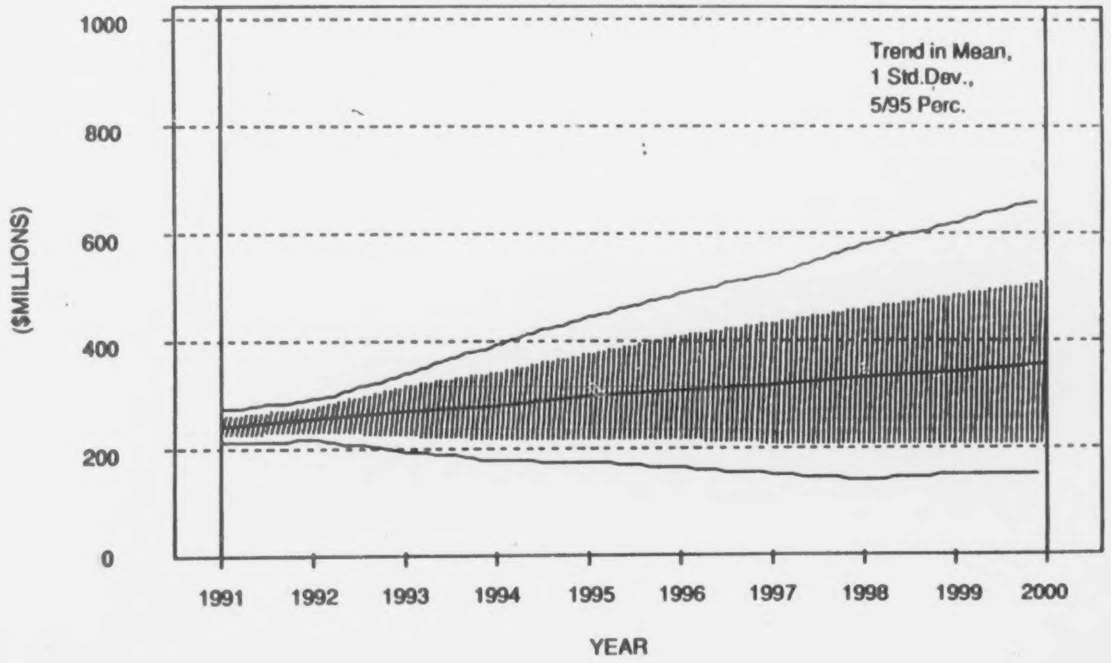
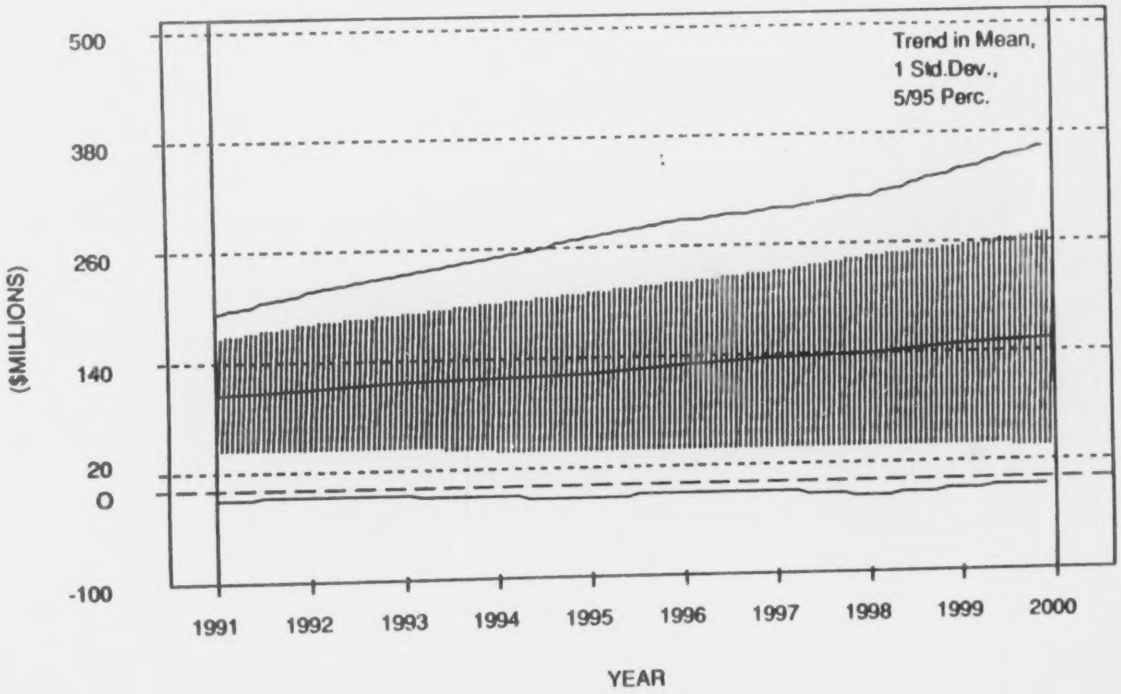


FIGURE 10.
NET CHANGE IN AIRLINE REVENUES, 1991-2000



IV. SENSITIVITY ANALYSIS

In addition to the sensitivity analysis implicit in the probabilistic framework of the analytic approach, one variable merited special scrutiny because of the wide range of impacts it could have on demand for air travel, fatalities, and airline revenues: the cost of an infant's ticket. The base case assumption for this analysis was that infants would be charged the same charge as children between the age of 2 and 12 (the lesser of 80 percent of the coach fare or the supersaver rate). On a weighted average basis, this means that an infant's ticket would cost 92 percent of the average adult's.

Airlines may, however, decide to use special reduced fares for infants to attract family travel. Table 5, below, presents the impact of different fare structures for infants on four variables: fatalities, injuries, costs to families, and airline revenues.

Table 5.
Impact of Infant Fare Structure on Key Outputs,
1991

Variable	Scenario[a]			
	Base	75%	50%	25%
NET INJURY DATA[b]				
FATALITIES	0.9	0.7	0.5	0.2
SERIOUS INJURIES	4.8	3.9	2.6	1.2
MINOR INJURIES	217.7	177.5	118.2	59.0
NET COST DATA[c]				
COST TO FAMILIES	$252M	$215M	$153M	$ 84M
NET AIRLINE REVENUES	119	107	80	45

NOTES:

a) Infant fare expressed as a percent of Adult Fare.

b) A positive change in net fatalities, net serious injuries, or net minor injuries indicates an increase. A negative change indicates a decrease.

c) All costs in millions of 1990 dollars.

Each 1 percent reduction in the cost of an infant's ticket would result in net reduction of 0.01 fatalities, or 0.29 fatalities for every reduction in cost of 25 percent. Similarly, both serious and minor injuries, could be expected to be reduced as the cost of an infant's ticket declines: each 1 percent decline in cost would result in 0.05 fewer serious injuries and 2.4 fewer minor injuries, or 1.3 and 59.3 fewer injuries for every 25 percent reduction, respectively. The reductions to both fatalities and injuries are directly attributable to the lower diversion to automobile travel that would occur for lower airline ticket prices.

This same change can be tracked in the net cost data. For example, each reduction to the infant ticket cost reduces the incremental cost to families. However, that lower cost to families means two things to airlines: (1) increased demand for air travel by families, and (2) decreased revenues. The net effect is that as infant ticket costs decline, net revenues for the airlines also decline. If the infant ticket cost were reduced to $0, of course, the only incremental cost would be that of the child safety seat -- a small cost relative to travel costs -- and little or no diversion to auto travel would result.

Because many of the qualitative costs and benefits were not quantified, this study does not address net societal or other costs (see Section III, page 30). Under the Base Case scenario, families that continue to fly will pay an additional $252 million dollars. However, some families will no longer fly and the airlines will lose revenue accordingly. As a result, the gain in net revenue to the airlines will be less than the additional cost to the families that continue to fly. This accounts for the difference between the Cost to Families and the Net Airline Revenues as shown in Table 5, and encompasses the aforementioned net societal and other costs.

APPENDIX A.
INPUTS: PRELIMINARY ESTIMATES AND FINAL VALUES BASED ON EXPERT PANEL INPUT

PRICE ELASTICITIES BY FAMILY TRAVEL UNIT AND TRAVEL DISTANCE				
Family Unit	0 to 600 Miles		600+ Miles	
	1990	2000	1990	2000
One Adult, One Child	-1.93	-1.93	-1.38	-1.38
Two Adults, One Child	-1.75	-1.75	-1.25	-1.25
Three Adults or Siblings, One Child	-1.57	-1.57	-1.12	-1.12
Two Adults or Siblings, Two Children	-1.93	-1.93	-1.38	-1.38

APPENDIX C.
MODEL STRUCTURE AND MEAN VALUES, 1991 TO 2010

TABLE 1.
BASE POPULATION DATA: ALL AIR TRAVEL

Year	Total Enplaned PAX (000s)	Enplaned Infants (<2 Years, in 000s)	Average R-T Travel Distance	Enplaned FTUs (000s)	Number of individuals in each FTU	Add'l Fares for CSS	Individuals paying fare	Percent Requiring Safety Seats
1989	480,400	4,009	2,052	3,678	4.06	1.09	2.97	N/A
1990	501,200	4,183	2,057	3,837	4.06	1.09	2.97	N/A
1991	526,800	4,396	2,062	4,033	4.06	1.09	2.97	20%
1992	551,900	4,606	2,067	4,226	4.06	1.09	2.97	20%
1993	574,700	4,796	2,072	4,400	4.06	1.09	2.97	20%
1994	600,600	5,012	2,077	4,598	4.06	1.09	2.97	5%
1995	628,000	5,241	2,083	4,808	4.06	1.09	2.97	5%
1996	656,800	5,481	2,088	5,029	4.06	1.09	2.97	5%
1997	685,600	5,722	2,093	5,249	4.06	1.09	2.97	5%
1998	715,000	5,967	2,098	5,474	4.06	1.09	2.97	5%
1999	744,900	6,217	2,103	5,703	4.06	1.09	2.97	5%
2000	775,100	6,469	2,108	5,934	4.06	1.09	2.97	5%
2001	806,800	6,733	2,114	6,177	4.06	1.09	2.97	5%
2002	839,072	7,002	2,119	6,424	4.06	1.09	2.97	5%
2003	872,635	7,283	2,124	6,681	4.06	1.09	2.97	5%
2004	907,540	7,574	2,129	6,948	4.06	1.09	2.97	5%
2005	943,842	7,877	2,135	7,226	4.06	1.09	2.97	5%
2006	981,596	8,192	2,140	7,515	4.06	1.09	2.97	5%
2007	1,020,859	8,520	2,145	7,816	4.06	1.09	2.97	5%
2008	1,061,694	8,860	2,150	8,129	4.06	1.09	2.97	5%
2009	1,104,162	9,215	2,156	8,454	4.06	1.09	2.97	5%
2010	1,148,328	9,583	2,161	8,792	4.06	1.09	2.97	5%

TABLE 2A.
POPULATION DATA: 0 to 600 MILES

Year	Percent of Air Travel <600 Miles	Enplaned Infants (<2 years) (000s)	Enplaned FTUs (000s)	Enplanements Per Round Trip	Number of FTU Trips	Average R-T Travel Distance	Total RPMs, 0 to 600 M (000s)
1989	0.13	521	478	2.2	217	405	357,377
1990	0.13	544	499	2.2	227	406	373,772
1991	0.13	572	524	2.2	238	407	393,833
1992	0.13	599	549	2.2	250	408	413,617
1993	0.13	623	572	2.2	260	409	431,768
1994	0.13	652	598	2.2	272	410	452,341
1995	0.13	681	625	2.2	284	411	474,146
1996	0.13	713	654	2.2	297	412	497,115
1997	0.13	744	682	2.2	310	413	520,195
1998	0.13	776	712	2.2	323	414	543,842
1999	0.13	808	741	2.2	337	415	567,984
2000	0.13	841	771	2.2	351	416	592,471
2001	0.13	875	803	2.2	365	417	618,225
2002	0.13	910	835	2.2	380	418	644,542
2003	0.13	947	869	2.2	395	419	671,979
2004	0.13	985	903	2.2	411	420	700,585
2005	0.13	1,024	939	2.2	427	421	730,408
2006	0.13	1,065	977	2.2	444	422	761,501
2007	0.13	1,108	1,016	2.2	462	423	793,917
2008	0.13	1,152	1,057	2.2	480	424	827,713
2009	0.13	1,198	1,099	2.2	500	425	862,947
2010	0.13	1,246	1,143	2.2	520	427	899,682

TABLE 2B.
POPULATION DATA: 600+ MILES

Year	Percent of Air Travel 600+ Miles	Enplaned Infants (<2 years) (000s)	Enplaned FTUs (000s)	Enplanements Per Round Trip	Number of FTU Trips	Average R-T Travel Distance	Total RPMs, 600 M+ (000s)	Total FTU PAX Miles (000s)
1989	0.87	3,488	3,200	2.8	1,143	2,298	10,662,644	11,020,021
1990	0.87	3,639	3,339	2.8	1,192	2,304	11,151,784	11,525,556
1991	0.87	3,825	3,509	2.8	1,253	2,309	11,750,340	12,144,173
1992	0.87	4,007	3,676	2.8	1,313	2,315	12,340,605	12,754,222
1993	0.87	4,173	3,828	2.8	1,367	2,321	12,882,158	13,313,927
1994	0.87	4,361	4,001	2.8	1,429	2,327	13,495,971	13,948,313
1995	0.87	4,560	4,183	2.8	1,494	2,332	14,146,527	14,620,673
1996	0.87	4,769	4,375	2.8	1,562	2,338	14,831,830	15,328,945
1997	0.87	4,978	4,567	2.8	1,631	2,344	15,520,431	16,040,626
1998	0.87	5,191	4,763	2.8	1,701	2,350	16,225,960	16,769,802
1999	0.87	5,408	4,962	2.8	1,772	2,355	16,946,254	17,514,238
2000	0.87	5,628	5,163	2.8	1,844	2,361	17,676,849	18,269,320
2001	0.87	5,858	5,374	2.8	1,919	2,367	18,445,244	19,063,469
2002	0.87	6,092	5,589	2.8	1,996	2,373	19,230,436	19,874,978
2003	0.87	6,336	5,813	2.8	2,076	2,379	20,049,052	20,721,032
2004	0.87	6,589	6,045	2.8	2,159	2,385	20,902,516	21,603,101
2005	0.87	6,853	6,287	2.8	2,245	2,391	21,792,311	22,522,719
2006	0.87	7,127	6,538	2.8	2,335	2,396	22,719,984	23,481,484
2007	0.87	7,412	6,800	2.8	2,429	2,402	23,687,146	24,481,063
2008	0.87	7,708	7,072	2.8	2,526	2,408	24,695,480	25,523,193
2009	0.87	8,017	7,355	2.8	2,627	2,414	25,746,737	26,609,684
2010	0.87	8,338	7,649	2.8	2,732	2,420	26,842,744	27,742,427

TABLE 3.
FARE DATA (Constant $1990)

Year	Revenue Per PAX-Mile (FAA Forecast, $1990)	Fare for Trips <= 600 Miles	Fare for Trips > 600 Miles
1989	0.13	0.24	0.11
1990	0.12	0.23	0.11
1991	0.12	0.22	0.11
1992	0.12	0.22	0.11
1993	0.12	0.22	0.11
1994	0.12	0.22	0.11
1995	0.12	0.22	0.11
1996	0.12	0.22	0.11
1997	0.12	0.22	0.10
1998	0.12	0.22	0.10
1999	0.12	0.22	0.10
2000	0.12	0.22	0.10
2001	0.12	0.22	0.10
2002	0.12	0.22	0.10
2003	0.12	0.22	0.10
2004	0.12	0.22	0.10
2005	0.12	0.22	0.10
2006	0.12	0.22	0.10
2007	0.12	0.22	0.10
2008	0.12	0.22	0.10
2009	0.12	0.22	0.10
2010	0.12	0.22	0.10

TABLE 4.
ANALYSIS: TRIPS 0 TO 600 MILES
COSTS

Year	Trip Duration (nights)	Average Adult Fare	Fare Cost Per FTU (No charge to Infants)	Non-Hotel Expenses Per Person Per Day ($1990)	Hotel Costs Per Person Per Day ($1990)	Percent Using Hotel	Other Travel Expenses Per Person, Average Trip ($1990)	Total Other Expenses Per FTU	TOTAL TRIP COST PER FTU	Average Non-Infant Cost	Total Trip Cost Per Person
1989	6.8	96	285	26	20	43%	229	929	1,214	409	299
1990	6.8	92	272	26	20	43%	229	929	1,201	404	296
1991	6.8	90	268	26	20	43%	229	929	1,197	403	295
1992	6.8	90	267	26	20	43%	229	929	1,196	403	295
1993	6.8	90	267	26	20	43%	229	929	1,196	403	295
1994	6.8	91	269	26	20	43%	229	929	1,198	403	295
1995	6.8	92	273	26	20	43%	229	929	1,201	404	296
1996	6.8	91	271	26	20	43%	229	929	1,200	404	295
1997	6.8	91	270	26	20	43%	229	929	1,198	404	295
1998	6.8	90	269	26	20	43%	229	929	1,197	403	295
1999	6.8	90	268	26	20	43%	229	929	1,196	403	295
2000	6.8	90	267	26	20	43%	229	929	1,195	402	294
2001	6.8	90	267	26	20	43%	229	929	1,196	403	295
2002	6.8	90	268	26	20	43%	229	929	1,197	403	295
2003	6.8	90	269	26	20	43%	229	929	1,197	403	295
2004	6.8	91	269	26	20	43%	229	929	1,198	403	295
2005	6.8	91	270	26	20	43%	229	929	1,199	404	295
2006	6.8	91	271	26	20	43%	229	929	1,199	404	295
2007	6.8	91	271	26	20	43%	229	929	1,200	404	296
2008	6.8	92	272	26	20	43%	229	929	1,201	404	296
2009	6.8	92	273	26	20	43%	229	929	1,201	404	296
2010	6.8	92	273	26	20	43%	229	929	1,202	405	296

TABLE 5.
ANALYSIS: TRIPS 0 TO 600 MILES
DIVERTED TRIPS

								FTUs AND AUTO MILEAGE	
Year	Incremental Cost Due to Infant Fare	New Total Trip Costs	Percent Change in Total Trip Costs	Elasticity of Demand for Trips <600 Miles	Percent Change in Total Trip Demand	Diverted FTU Trips (000s)	Effective PAX Miles (000s)	FTU Trips by Car (000s)	Passenger Miles by Car (000s)
1989	88	1,302	7.3%	-1.7	-12.7%	28	45,400	19	41,314
1990	84	1,285	7.0%	-1.7	-12.3%	28	45,816	19	41,692
1991	83	1,280	6.9%	-1.7	-12.1%	29	47,714	20	43,420
1992	83	1,279	6.9%	-1.7	-12.1%	30	49,963	21	45,467
1993	83	1,279	6.9%	-1.7	-12.1%	31	52,171	22	47,476
1994	83	1,282	7.0%	-1.7	-12.2%	33	54,984	23	50,036
1995	84	1,286	7.0%	-1.7	-12.3%	35	58,165	24	52,930
1996	84	1,284	7.0%	-1.7	-12.2%	36	60,707	25	55,244
1997	83	1,282	7.0%	-1.7	-12.2%	38	63,287	26	57,591
1998	83	1,281	6.9%	-1.7	-12.1%	39	65,966	27	60,029
1999	83	1,279	6.9%	-1.7	-12.1%	41	68,686	29	62,504
2000	83	1,278	6.9%	-1.7	-12.1%	42	71,428	30	65,000
2001	83	1,279	6.9%	-1.7	-12.1%	44	74,676	31	67,955
2002	83	1,280	6.9%	-1.7	-12.1%	46	78,004	32	70,984
2003	83	1,280	6.9%	-1.7	-12.1%	48	81,480	34	74,147
2004	83	1,281	7.0%	-1.7	-12.1%	50	85,112	35	77,452
2005	84	1,282	7.0%	-1.7	-12.2%	52	88,905	36	80,903
2006	84	1,283	7.0%	-1.7	-12.2%	54	92,866	38	84,508
2007	84	1,284	7.0%	-1.7	-12.2%	56	97,005	40	88,274
2008	84	1,285	7.0%	-1.7	-12.2%	59	101,327	41	92,208
2009	84	1,286	7.0%	-1.7	-12.3%	61	105,842	43	96,317
2010	85	1,287	7.0%	-1.7	-12.3%	64	110,559	45	100,608

TABLE 6.
ANALYSIS: TRIPS 600+ MILES
COSTS

Year	Trip Duration (nights)	Average Adult Fare	Fare Cost Per FTU (No Rule)	Other Travel Expenses Per Person Per Day ($1990)	Hotel Costs Per Person Per Day ($1990)	Percent Using Hotel	Other Travel Expenses Per Person, Average Trip ($1990)	Total Other Expenses Per FTU	TOTAL TRIP COST PER FTU	Average Non-Infant Cost	Total Trip Cost Per Person
1989	7.6	260	773	26	20	53%	273	1,110	1,883	634	464
1990	7.6	248	738	26	20	53%	273	1,110	1,848	622	455
1991	7.6	245	727	26	20	53%	273	1,110	1,837	618	452
1992	7.6	244	724	26	20	53%	273	1,110	1,834	618	452
1993	7.6	244	724	26	20	53%	273	1,110	1,834	618	452
1994	7.6	246	730	26	20	53%	273	1,110	1,840	620	453
1995	7.6	249	738	26	20	53%	273	1,110	1,849	622	455
1996	7.6	247	734	26	20	53%	273	1,110	1,844	621	454
1997	7.6	246	730	26	20	53%	273	1,110	1,841	620	453
1998	7.6	245	728	26	20	53%	273	1,110	1,838	619	453
1999	7.6	244	725	26	20	53%	273	1,110	1,835	618	452
2000	7.6	243	722	26	20	53%	273	1,110	1,832	617	451
2001	7.6	244	724	26	20	53%	273	1,110	1,834	618	452
2002	7.6	244	726	26	20	53%	273	1,110	1,836	618	452
2003	7.6	245	727	26	20	53%	273	1,110	1,838	619	453
2004	7.6	245	729	26	20	53%	273	1,110	1,839	619	453
2005	7.6	246	731	26	20	53%	273	1,110	1,841	620	454
2006	7.6	247	733	26	20	53%	273	1,110	1,843	621	454
2007	7.6	247	735	26	20	53%	273	1,110	1,845	621	454
2008	7.6	248	736	26	20	53%	273	1,110	1,847	622	455
2009	7.6	249	738	26	20	53%	273	1,110	1,848	622	455
2010	7.6	249	740	26	20	53%	273	1,110	1,850	623	456

TABLE 7.
ANALYSIS: TRIPS 600+ MILES
DIVERTED TRIPS

FTUs AND AUTO MILEAGE

Year	Incremental Cost Due to Infant Fare	New Total Trip Costs	Percent Change in Total Trip Costs	Elasticity of Demand for Trips <600 Miles	Percent Change in Total Trip Demand	Diverted FTU Trips (000s)	Effective PAX Miles (000s)	FTU Trips by Car by Car (000s)	Passenger Miles by Car (000s)
1989	239	2,122	12.7%	-1.4	-17.7%	203	1,890,906	41	491,636
1990	228	2,076	12.4%	-1.4	-17.3%	206	1,923,694	41	500,160
1991	225	2,062	12.2%	-1.4	-17.1%	214	2,008,599	43	522,236
1992	224	2,058	12.2%	-1.4	-17.1%	224	2,104,652	45	547,210
1993	224	2,058	12.2%	-1.4	-17.1%	233	2,197,502	47	571,351
1994	226	2,066	12.3%	-1.4	-17.1%	245	2,312,956	49	601,368
1995	229	2,077	12.4%	-1.4	-17.3%	258	2,441,774	52	634,861
1996	227	2,072	12.3%	-1.4	-17.2%	269	2,551,073	54	663,279
1997	226	2,067	12.3%	-1.4	-17.1%	280	2,661,694	56	692,041
1998	225	2,063	12.3%	-1.4	-17.1%	291	2,776,210	58	721,815
1999	224	2,059	12.2%	-1.4	-17.1%	302	2,892,617	60	752,080
2000	223	2,056	12.2%	-1.4	-17.0%	314	3,010,129	63	782,634
2001	224	2,058	12.2%	-1.4	-17.1%	327	3,145,673	65	817,875
2002	225	2,060	12.2%	-1.4	-17.1%	341	3,284,480	68	853,965
2003	225	2,063	12.3%	-1.4	-17.1%	355	3,429,407	71	891,646
2004	226	2,065	12.3%	-1.4	-17.1%	370	3,580,723	74	930,988
2005	226	2,067	12.3%	-1.4	-17.2%	385	3,738,711	77	972,065
2006	227	2,070	12.3%	-1.4	-17.2%	401	3,903,664	80	1,014,953
2007	227	2,072	12.3%	-1.4	-17.2%	418	4,075,888	84	1,059,731
2008	228	2,075	12.3%	-1.4	-17.2%	435	4,255,705	87	1,106,483
2009	228	2,077	12.4%	-1.4	-17.3%	453	4,443,448	91	1,155,296
2010	229	2,079	12.4%	-1.4	-17.3%	472	4,639,466	94	1,206,261

TABLE 8.
TOTAL AUTO PAX MILES (000s)

Year	Total	Non Infants	Infants
1989	532,950	389,867	143,083
1990	541,853	396,380	145,473
1991	565,656	413,793	151,863
1992	592,676	433,559	159,118
1993	618,826	452,688	166,138
1994	651,404	476,520	174,884
1995	687,791	503,138	184,653
1996	718,523	525,619	192,904
1997	749,632	548,376	201,256
1998	781,844	571,940	209,904
1999	814,585	595,891	218,694
2000	847,633	620,067	227,567
2001	885,830	648,009	237,821
2002	924,948	676,625	248,324
2003	965,793	706,504	259,289
2004	1,008,440	737,701	270,739
2005	1,052,968	770,275	282,693
2006	1,099,461	804,285	295,175
2007	1,148,005	839,797	308,208
2008	1,198,691	876,875	321,816
2009	1,251,613	915,589	336,024
2010	1,306,870	956,010	350,859

TABLE 9.
FATALITY RATES

AVIATION			AUTOMOBILE	
			Fatality Rates Per PAX (Per 100M Passenger Miles)	
Year	Fatality Rates (Per 100M Revenue Passenger Miles), All PAX	Net Change in Infant PAX Fatality (W/CSS)	Overall	Infant W/CSS
1991	0.05	0.003	0.41	0.21
1992	0.05	0.003	0.40	0.20
1993	0.05	0.003	0.39	0.19
1994	0.05	0.003	0.37	0.19
1995	0.05	0.003	0.36	0.18
1996	0.05	0.003	0.35	0.18
1997	0.05	0.003	0.35	0.18
1998	0.05	0.003	0.35	0.18
1999	0.05	0.003	0.35	0.18
2000	0.05	0.003	0.35	0.18
2001	0.05	0.003	0.35	0.18
2002	0.05	0.003	0.35	0.18
2003	0.05	0.003	0.35	0.18
2004	0.05	0.003	0.35	0.18
2005	0.05	0.003	0.35	0.18
2006	0.05	0.003	0.35	0.18
2007	0.05	0.003	0.35	0.18
2008	0.05	0.003	0.35	0.18
2009	0.05	0.003	0.35	0.18
2010	0.05	0.003	0.35	0.18

TABLE 10.
FORECAST FATALITIES FOR FAMILY INDIVIDUALS

	AVIATION TRIPS							DIVERTED TRIPS			SUMMARY
Year	Net Change in Non-Infant Fatalities:			Net Change in Infant Fatalities:			Subtotal: Aviation	Non-Infants Net Increase (Decrease)	Infants Net Increase (Decrease)	Subtotal: Automobile	Overall Increase (Decrease) Due to CSS
	Base Case (No CSS)	W/ Changed Demand	Net Increase (Decrease)	Due to Decreased Demand	Due to CSS Use	Net Increase (Decrease)					
1991	4.5	3.7	-0.8	-0.3	-0.1	-0.4	-1.1	1.7	0.3	2.0	0.9
1992	4.7	3.9	-0.8	-0.3	-0.1	-0.4	-1.2	1.7	0.3	2.0	0.9
1993	4.9	4.1	-0.8	-0.3	-0.1	-0.4	-1.2	1.7	0.3	2.1	0.8
1994	5.2	4.3	-0.9	-0.3	-0.1	-0.4	-1.3	1.8	0.3	2.1	0.8
1995	5.4	4.5	-0.9	-0.3	-0.1	-0.4	-1.4	1.8	0.3	2.1	0.8
1996	5.7	4.7	-1.0	-0.4	-0.1	-0.5	-1.4	1.8	0.3	2.2	0.7
1997	5.9	4.9	-1.0	-0.4	-0.1	-0.5	-1.5	1.9	0.4	2.3	0.8
1998	6.2	5.2	-1.1	-0.4	-0.1	-0.5	-1.6	2.0	0.4	2.4	0.8
1999	6.5	5.4	-1.1	-0.4	-0.1	-0.5	-1.6	2.1	0.4	2.5	0.8
2000	6.8	5.6	-1.1	-0.4	-0.1	-0.5	-1.7	2.2	0.4	2.6	0.9
2001	7.1	5.9	-1.2	-0.4	-0.1	-0.6	-1.8	2.3	0.4	2.7	0.9
2002	7.4	6.1	-1.2	-0.5	-0.1	-0.6	-1.8	2.4	0.4	2.8	1.0
2003	7.7	6.4	-1.3	-0.5	-0.1	-0.6	-1.9	2.5	0.5	2.9	1.0
2004	8.0	6.7	-1.4	-0.5	-0.1	-0.6	-2.0	2.6	0.5	3.1	1.0
2005	8.4	6.9	-1.4	-0.5	-0.2	-0.7	-2.1	2.7	0.5	3.2	1.1
2006	8.7	7.2	-1.5	-0.5	-0.2	-0.7	-2.2	2.8	0.5	3.3	1.1
2007	9.1	7.5	-1.5	-0.6	-0.2	-0.7	-2.3	2.9	0.5	3.5	1.2
2008	9.5	7.9	-1.6	-0.6	-0.2	-0.8	-2.4	3.1	0.6	3.6	1.2
2009	9.9	8.2	-1.7	-0.6	-0.2	-0.8	-2.5	3.2	0.6	3.8	1.3
2010	10.3	8.5	-1.8	-0.6	-0.2	-0.8	-2.6	3.3	0.6	4.0	1.4

TABLE 10A.
FORECAST NET CHANGE IN SERIOUS INJURIES

	AVIATION		AUTO		
Year	Non-Infant	Infant	Non-Infant	Infant	Overall Net Change
1991	-0.2	-0.4	4.6	0.8	4.8
1992	-0.2	-0.4	4.6	0.8	4.8
1993	-0.2	-0.4	4.6	0.9	4.9
1994	-0.3	-0.4	4.7	0.9	4.9
1995	-0.3	-0.4	4.8	0.9	5.0
1996	-0.3	-0.5	4.9	0.9	5.1
1997	-0.3	-0.5	5.1	0.9	5.3
1998	-0.3	-0.5	5.3	1.0	5.5
1999	-0.3	-0.5	5.6	1.0	5.7
2000	-0.3	-0.5	5.8	1.1	6.0
2001	-0.3	-0.6	6.0	1.1	6.2
2002	-0.4	-0.6	6.3	1.2	6.5
2003	-0.4	-0.6	6.6	1.2	6.8
2004	-0.4	-0.6	6.9	1.3	7.1
2005	-0.4	-0.7	7.2	1.3	7.4
2006	-0.4	-0.7	7.5	1.4	7.7
2007	-0.4	-0.7	7.8	1.4	8.1
2008	-0.5	-0.8	8.2	1.5	8.4
2009	-0.5	-0.8	8.5	1.6	8.8
2010	-0.5	-0.8	8.9	1.6	9.2

TABLE 10B.
FORECAST NET CHANGE IN MINOR INJURIES

	AVIATION		AUTO		
Year	Non-Infant	Infant	Non-Infant	Infant	Overall Net Change
1991	-0.6	-1.3	185.4	34.0	217.6
1992	-0.6	-1.3	187.5	34.4	220.0
1993	-0.6	-1.4	188.9	34.7	221.5
1994	-0.7	-1.5	191.9	35.2	225.0
1995	-0.7	-1.5	195.5	35.9	229.2
1996	-0.7	-1.6	199.1	36.5	233.3
1997	-0.7	-1.7	207.7	38.1	243.4
1998	-0.8	-1.8	216.7	39.8	253.9
1999	-0.8	-1.8	225.7	41.4	264.5
2000	-0.8	-1.9	234.9	43.1	275.2
2001	-0.9	-2.0	245.5	45.0	287.7
2002	-0.9	-2.1	256.3	47.0	300.4
2003	-1.0	-2.2	267.6	49.1	313.6
2004	-1.0	-2.3	279.5	51.3	327.5
2005	-1.1	-2.4	291.8	53.5	341.9
2006	-1.1	-2.5	304.7	55.9	357.0
2007	-1.1	-2.6	318.1	58.4	372.8
2008	-1.2	-2.7	332.2	61.0	389.3
2009	-1.2	-2.8	346.8	63.6	406.4
2010	-1.3	-2.9	362.2	66.5	424.4

TABLE 11.

INCREMENTAL COSTS OF MANDATORY CSS IMPLEMENTATION TO FTUs

							TO AIRLINES		
Year	Total Cost, New Tickets (000s)	Average New Ticket Costs Per FTU	Child Safety Seat (CSS) Purchases (000s)	Average CSS Cost Per FTU	Average Incremental Cost Per FTU	Total FTU Incremental Costs (000s)	Airline Revenue (No CSS, 000s)	Airline Revenue (With CSS, 000s)	Dollar Change in Revenues (000s)
1991	246,593	181	5,443	4	185	252,036	1,075,436	1,194,756	119,319
1992	256,282	180	5,705	4	184	261,987	1,122,400	1,247,518	125,118
1993	269,799	182	5,941	4	186	275,739	1,169,199	1,299,475	130,276
1994	284,636	184	1,551	1	185	286,187	1,231,343	1,367,236	135,892
1995	299,268	185	1,619	1	186	300,887	1,302,837	1,444,491	141,655
1996	311,148	184	1,695	1	185	312,843	1,354,638	1,503,020	148,382
1997	324,055	183	1,770	1	184	325,824	1,407,172	1,562,254	155,081
1998	337,918	183	1,847	1	184	339,764	1,461,858	1,623,745	161,887
1999	351,639	183	1,925	1	184	353,564	1,517,059	1,685,874	168,815
2000	365,580	182	2,004	1	183	367,583	1,572,351	1,748,173	175,822
2001	381,726	183	2,085	1	184	383,811	1,640,700	1,823,607	182,907
2002	398,079	184	2,168	1	185	400,247	1,710,542	1,900,655	190,112
2003	415,293	184	2,254	1	185	417,547	1,783,358	1,980,957	197,599
2004	432,827	185	2,343	1	186	435,170	1,859,273	2,064,652	205,378
2005	451,102	185	2,436	1	186	453,538	1,938,420	2,151,882	213,461
2006	470,148	186	2,533	1	187	472,681	2,020,937	2,242,797	221,860
2007	489,998	186	2,634	1	187	492,631	2,106,965	2,337,552	230,587
2008	510,686	187	2,738	1	188	513,424	2,196,656	2,436,310	239,654
2009	532,247	187	2,847	1	188	535,094	2,290,165	2,539,240	249,075
2010	554,718	187	2,960	1	188	557,678	2,387,655	2,646,518	258,863
TOTAL	7,683,740	3,679	54,496	29	3,708	7,738,237	33,148,967	36,800,710	3,651,743
NPV(10%)	2,872,048	1,559	26,251	16	1,575	2,898,300	12,423,445	13,795,528	1,372,083

APPENDIX D.
SUMMARIES OF AIRLINE ACCIDENTS WITH SURVIVORS AND INFANT INJURIES

INCIDENTS/ACCIDENTS

PENSACOLA, FL
MAY 8, 1978

One child, age 2 1/2, sustained a minor injury (a contusion to the face and right hand) when a National Airlines flight crashed into the bay in Pensacola. A total of 52 passengers were onboard. Of these, 3 were fatally injured, nine were seriously injured, 17 sustained minor injuries, while 23 were not injured. Based on available information, the child was probably not a lap child, and thus, had its own seat and seatbelt. Additionally, the individual in the adjoining seat, as well as the individual occupying the seat one row back and one seat over, were fatally injured. Therefore, the injury would not have been preventable had the infant been restrained in a child safety seat.

AUSTIN, TX
AUGUST 13, 1978

One infant sustained a minor injury when a Tejas Airlines flight crashed in Austin. A total of 16 passengers were onboard, including the infant. Of these, 1 passenger was seriously injured while each of the remaining passengers sustained a minor injury. Because all passengers were injured in the accident, a child safety seat would not have prevented the infant from being injured.

STEAMBOAT SPRINGS, CO
DECEMBER 4, 1978

An 8-month-old infant was one of 22 passengers aboard a Rocky Mountain Airways flights that crashed in Steamboat Springs. Two individuals were fatally injured, 14 were seriously injured, while the remaining 6, including the infant, had minor injuries. All occupants sustained some form of injury. Therefore, a child safety seat would not have prevented the infant from sustaining a minor injury.

PORTLAND, OR
DECEMBER 28, 1978

Three infants were among 8 passengers fatally injured when a United Airlines flight crashed in Portland. One-hundred seventy-nine passengers were aboard the flight. In addition to the fatalities, 1 passenger was seriously injured, and 22 received minor injuries. The remaining 148 were uninjured. All 8 deaths were to passengers seated in the first five rows on the right hand side of the plane, which is where the 3 fatally wounded infants were situated. There was very little chance of survival, if any, to those in this section of the aircraft. Despite the high frequency of survivors, the fatalities to the infants could not have been prevented had they been secured in a child safety seat.

CATALINA ISLAND, CA
APRIL 14, 1979

A two-year-old child, travelling as a lap child, sustained minor injuries when a Catalina Air Lines flight crashed on its approach to Catalina Island. Of the 10 passengers onboard, 1 was fatally injured, 2 were seriously injured, while the remaining 7 passengers sustained minor injuries. All of the plane's occupants were injured. Therefore, a child safety seat could have prevented an injury.

WASHINGTON, DC
JANUARY 13, 1982

Three infants were fatally injured when an Air Florida flight crashed into the Potomac River. 79 persons were aboard the plane, including 2 cockpit crewmembers and 3 flight attendants. Five persons sustained serious injuries, including 1 flight attendant, while the remaining 74 persons (94 percent) were fatally injured. Only 1 person died of water inhalation; all others died of impact injuries. None of the parents holding the infants survived, and there were no survivors in the first 16 rows of the aircraft, where 2 of the infants were situated. Based on the small percentage of survivors and the fact that water evacuation took place, there is very little chance that the infant fatalities would have been preventable. Child safety seats would not have saved the infants lives.

TAU, MANUA, AMERICAN SAMOA
JULY 21, 1984

An infant was 1 of 12 passengers and crew injured when a commuter flight crashed in Tau, American Samoa. There was one fatality on the flight. Four persons were seriously injured, while the remaining 7 individuals onboard sustained minor injuries. All passengers were injured. According to information that is available, it is probable that the infant was 1 of the 4 seriously injured. Each of the passengers seated directly around the infant, including the individual holding the infant, sustained only minor injuries, as did the majority of passengers on the plane. Therefore, the infant may have received only minor injuries had it been properly restrained in a child safety seat.

ATLANTIC OCEAN
MAY 28, 1985

In-flight turbulence over the Atlantic Ocean injured 21 occupants. One flight attendant and 18 passengers received minor injuries and 2 passengers received serious injuries. The minor injuries consisted of soft tissue contusions, aches and sprains. One 8-month-old infant flew from the seat to the ceiling and then fell on the arm rest and finally to the floor. The infant sustained trauma to the left jaw, but no fracture. If the child were placed in a child safety seat, it would not have sustained the injury.

DALLAS-FT. WORTH, TX
AUGUST 2, 1985

Thirty-four persons survived the crash of a Delta flight that occurred at Dallas-Ft. Worth. Of the 152 passengers on board 126 died on impact, 14 sustained serious injuries, 10 had minor injuries, and 2 had no injuries. Eleven crew members were onboard. Eight were fatally injured, 1 had a serious injury, and 1 had minor injuries. There was one infant fatality. The exact seating location of the infant is unknown, but it is known that it was somewhere in the first 20 rows. There were no survivors in the first 20 rows. Therefore, this infant fatality was unpreventable.

WEST PALM BEACH, FL
JULY 13, 1986

An infant sustained minor injuries when an Eastern Airlines flight experienced in-flight turbulence en route to West Palm Beach. The incident resulted in serious injuries to 2 passengers and minor injuries to 28 passengers, including the infant. One-hundred ninety-nine passengers were uninjured. The 7-month-old baby was injured when it went up in the air and, according its mother, "landed on the armrest of the seat in front of us." The baby's left temple was bruised. If the child were placed in a child safety seat, it would not have sustained the injury.

CHARLOTTE, NC
OCTOBER 25, 1986

One infant received a minor injury when a flight crashed in Charlotte. Of the 119 passengers onboard, there were no fatalities, 3 serious injuries, and 31 minor injuries, while the remaining 85 passengers were uninjured. According to the crash analysis, the parent holding the infant was not injured, suggesting the infant would not have been injured had it been secured in a child safety seat.

DENVER, CO
NOVEMBER 15, 1987

One infant was killed aboard a flight that crashed in Denver in which 25 were fatally injured and 25 seriously injured. Of the remaining passengers, 24 received minor injuries, while one passenger, an infant was not injured. Because the fatally injured infant was in a section of the plane in which there were no survivors, despite the high number of survivors, the infant fatality could not have been prevented had it been restrained in a child safety seat.

KENAI, AK
DECEMBER 23, 1987

Very little information is available on the injuries and the nature of the fatalities to the passengers. Six passengers, including a lap child, and the lone crew member were killed in the crash of the commuter plane. Two passengers survived with serious injuries. Both the mother and lap child died on impact. The father survived with serious injuries. NTSB did not send a person to investigate the human survival factors of this crash but the structural factors investigator indicated that this was not a survivable crash and believed that the two survivors were fortunate to have lived. Therefore, a child safety seat would not have prevented a fatal injury to the child.

DALLAS-FT. WORTH, TX
AUGUST 31, 1988

A Delta flight with 108 passengers onboard, including three lap children and seven crew members, crashed on takeoff from Dallas-Ft. Worth. Fourteen occupants were fatally injured, twenty-six received serious injuries, fifty sustained minor injuries and eighteen people were not injured. The injured occupants received a variety of traumatic injuries and burns. Thirteen of the fourteen fatalities were caused by smoke inhalation. The fourteenth person who died was a passenger who had successfully evacuated the plane but attempted to reenter and sustained severe burns. Two infants sustained minor injuries and one was not injured. Because of the nature of the injuries to the airplane's occupants, injuries to the lap children were unpreventable.

SIOUX CITY, IA
JULY 19, 1989

There were 257 occupants on United Airline's July 19 flight including four lap children. Three lap children sustained minor injuries and one was fatally injured. Two of the lap children were separated from their mother's grasp during the crash. One survived and the other died from smoke inhalation. The mother of the dead infant sustained no physical injuries. The fatally injured infant was found in an area of the plane where the majority of the people died from smoke inhalation. Because of the lack of physical injury to the mother and the cause of the death to the infant, a child safety seat would have prevented this fatality.

SAN JUAN, PR
JANUARY 20, 1990

A 7-week-old infant was seriously injured when an American Airlines flight experienced in-flight turbulence near San Juan. Of 179 passengers onboard, the only reported injuries were those to the infant and minor injuries to a pregnant woman who was admitted to the hospital for observation. The infant reportedly had bruises to the head, and the eyes, as well as a fracture to the skull. Since the infant injury was isolated and was sustained in-flight, it could have been prevented had the infant been properly restrained in a child safety seat.

PRICE ELASTICITIES BY FAMILY TRAVEL UNIT AND TRAVEL DISTANCE

Number of Infants (<2) in Family Travel Unit	0 to 600 Miles	600+ Miles
One	-1.93 (+/- 30%)	-1.38 (+/- 30%)
Two	-1.57 (+/- 30%)	-1.12 (+/- 30%)

TAKING THE SAME TRIP BY AUTOMOBILE BY DISTANCE AND FAMILY UNIT (1990)						
Family Unit	0 to 600 Miles			600+ Miles		
	Same Trip by Car	Alter-native Car Trip	No Trip	Same Trip by Car	Alter-native Car Trip	No Trip
One Adult, One Child	20%	20%	60%	5%	35%	60%
Two Adults, One Child	70	20	10	25	65	10
Three Adults or Siblings, One Child	30	40	30	10	60	30
Two Adults or Siblings, Two Children	30	40	30	10	60	30

TAKING THE SAME TRIP BY AUTOMOBILE BY DISTANCE AND FAMILY UNIT (2000)						
Family Unit	0 to 600 Miles			600+ Miles		
	Same Trip by Car	Alter-native Car Trip	No Trip	Same Trip by Car	Alter-native Car Trip	No Trip
One Adult, One Child	20%	20%	60%	5%	35%	60%
Two Adults, One Child	70	20	10	25	65	10
Three Adults or Siblings, One Child	30	40	30	10	60	30
Two Adults or Siblings, Two Children	30	40	30	10	60	30

TAKING THE SAME TRIP BY AUTOMOBILE BY DISTANCE AND FAMILY UNIT (1990)				
	0 to 600 Miles		600+ Miles	
	Same Trip by Car	No Trip	Same Trip by Car	No Trip
Family Travel Unit	70% +/- (.20*.20)	30% (1-STBC)	20% +/-(.20*.20)	80% (1-STBC)

NOTE: Distribution remains constant throughout forecast period.

UPPER AND LOWER BOUNDS FOR TAKING THE SAME TRIP BY AUTOMOBILE BY DISTANCE AND FAMILY UNIT
(1990)

Family Unit	0 to 600 Miles			600+ Miles		
	Lower 10%	Mean	Upper 10%	Lower 10%	Mean	Upper 10%
One Adult, One Child	5%	20%	30%	5%	35%	60%
Two Adults, One Child	50	70	95	10	25	50
Three Adults/Siblings One Child	10	30	40	0	10	20

UPPER AND LOWER BOUNDS FOR TAKING THE SAME TRIP BY AUTOMOBILE BY DISTANCE AND FAMILY UNIT
(2000)

Family Unit	0 to 600 Miles			600+ Miles		
	Lower 10%	Mean	Upper 10%	Lower 10%	Mean	Upper 10%
One Adult, One Child	5%	20%	30%	5%	35%	60%
Two Adults, One Child	50	70	95	10	25	50
Three Adults/Siblings One Child	10	30	40	0	10	20

SEE PAGE A-4

PERCENT OF FAMILIES ELECTING TO BRING OWN CSS ON BOARD						
Distance	Lower 10%		Mean		Upper 10%	
	1990	2000	1990	2000	1990	2000
0 to 600 Miles	70%	70%	80%	80%	90%	90%
600+ Miles	70	70	80	80	90	90

PERCENT OF DEMAND FOR CSSs MET BY AIRLINES						
	Lower 10%		Mean		Upper 10%	
	1990	2000	1990	2000	1990	2000
Percent of Demand	20%	20%	50%	50%	70%	70%

INFANT FARE STRUCTURE (AS A FUNCTION OF COACH)						
Ticket Type	Lower 10%		Mean		Upper 10%	
	1990	2000	1990	2000	1990	2000
Percent of Coach	70%	70%	80%	80%	85%	85%
Supersaver	45	45	50	50	55	55

PERCENT OF FAMILIES STAYING IN HOTEL						
Distance	Lower 10%		Mean		Upper 10%	
	1990	2000	1990	2000	1990	2000
0 to 600 Miles	19%	19%	29%	29%	39%	39%
600+ Miles	24	24	34	34	44	44

PERCENT OF FAMILIES ELECTING TO BRING OWN CSS ON BOARD			
Distance	ower 10%	Mean	Upper 10%
0 to 600 Miles	90%	95%	99%
600+ Miles	90	95	99

NOTE: For first three years, 80% of families will bring CSS on board. In following years, 95% will bring CSS on board.

PERCENT OF CSSs MET BY AIRLINES			
	Lower 10%	Mean	Upper 10%
Percent of Demand	10%	5%	1%

NOTE: Values equal (1 - Percent of Families Electing to Bring Own CSS On Board).

INFANT FARE STRUCTURE (AS A FUNCTION OF COACH)			
Ticket Type	Lower 10%	Mean	Upper 10%
Percent of Coach	80%	80%	80%
Supersaver	22	37	50

PERCENT OF FAMILIES STAYING IN HOTEL			
Distance	Lower 10%	Mean	Upper 10%
0 to 600 Miles	33%	43%	53%
600+ Miles	43	53	63

NOTE: Distribution remains constant throughout forecast period.

TRIP DURATION IN NIGHTS						
Distance	Lower 10%		Mean		Upper 10%	
	1990	2000	1990	2000	1990	2000
0 to 600 Miles	1.9	1.9	6.6	6.6	11.9	11.9
600+ Miles	2.6	2.6	7.6	7.6	12.6	12.6

ADJUSTMENT TO INFANT FATALITY ESTIMATE DUE TO CSS						
Percent Reduction	Lower 10%		Mean		Upper 10%	
	1990	2000	1990	2000	1990	2000
Air Travel	59%	59%	69%	69%	89%	89%
Auto Travel	64	64	69	69	74	74

TRIP DURATION IN NIGHTS			
Distance	Lower 10%	Mean	Upper 10%
0 to 600 Miles	2.6	6.6	10.1
600+ Miles	2.6	8.1	12.1

ADJUSTMENT TO INFANT FATALITY ESTIMATE DUE TO CSS			
Percent Reduction	Lower 10%	Mean	Upper 10%
Air Travel	20%	50%	70%
Auto Travel	64	69	74

NOTE: Auto travel rates are for all accidents (survivable and non-survivable). Air travel rates based on survivable accidents only.

APPENDIX B.
EXPERT PANEL MEMBERS

INVITEES:

Mark Berno
Pricing Analyst
Northwest Airlines
Minneapolis/St. Paul International Airport
St. Paul, MN 55111

Paul Biederman
Director
Forecasting and Economic Analysis
TWA
110 South Bedford Road
Mt. Kisco, NY 10549

Avery Coryell*
Senior Specialist in Fleet Planning
American Airlines
P.O. Box 619616
Dallas-Ft. Worth Airport
Dallas, TX 75261-9616

Tom Craig
Former Director, Boeing Aircraft
9842 N.E. 15th Avenue
Bellevue, WA 98004

Leonard Evans*
Principal Research Scientist
Operating Sciences Department
General Motors Research Laboratories
Warren, Michigan 48090

Art Hayes
AIR-120
Federal Aviation Administration
800 Independence Ave., SW
Washington, DC 20591

Don Kern
Manager
Domestic Route Development
Delta Air Lines

Hartsfield Atlanta International Airport
Atlanta, GA 30320

Bob Ketelsen
Director
Onboard Planning
United Airlines
P.O. Box 66100
Mail Code EXOLA
Chicago, IL 60666

Bruce Mainzer
Director
Market Analysis
United Airlines
P.O. Box 66100
Chicago, IL 60666

Nora Marshall
National Transportation Safety Board
TE-10, Room 831A
800 Independence Ave., SW
Washington, DC 20591

Gene Mercer*
APO-110
Federal Aviation Administration
800 Independence Ave., SW
Washington, DC 20591

Ron Miller
Managing Director
Domestic Pricing
American Airlines
P.O. Box 619616
Dallas-Ft. Worth Airport
Dallas, TX 75261

Ed Mudrowsky*
National Transportation Safety Board
TE-10, Room 828E
800 Independence Ave., SW
Washington, DC 20591

Susan Partyka*
U.S. Department of Transportation
National Highway Traffic Safety Administration
NRM-10, Room 5320
400 7th St., SW
Washington, DC 20590

Tom Smith*
APO-210
Federal Aviation Administration
800 Independence Ave., SW
Washington, DC 20591

Suzanne Stack*
National Transportation Safety Board
SP-10, Room 834
800 Independence Ave., SW
Washington, DC 20591

David Teitelbaum*
APO-210
Federal Aviation Administration
800 Independence Ave., SW
Washington, DC 20591

Steve Zaidman*
AOR-1
Federal Aviation Administration
800 Independence Ave., SW
Washington, DC 20591

*Attended Session

TESTIMONY OF

JAN BROWN,
MEMBER OF THE ASSOCIATION OF FLIGHT ATTENDANTS, AFL-CIO

MANDATORY CHILD RESTRAINT SEATS

Before the Subcommittee on Aviation
House Committee on Public Works and Transportation

July 12, 1990

Good afternoon Mr. Chairman and Members of the Subcommittee.

My name is Jan Brown. I have been a flight attendant with United Airlines and a member of the Association of Flight Attendants, AFL-CIO for 13 years. Last year on July 19th, I was working United Airlines Flight 232 from Denver to Chicago when the hydraulic system failed and we made an emergency landing in Sioux City, Iowa. For 40 terrifying minutes, I and the other flight attendants onboard prepared the cabin and passengers, including the infants sitting on their parents laps, for the emergency landing and evacuation. It is an honor to be here today to briefly tell you about my experience on Flight 232 and to discuss the life-saving importance of requiring child restraint seats on airplanes for children under two years old.

As a flight attendant, my primary responsibility is safety. I am responsible for carrying out many of the Federal Aviation Administration's regulations which protect the flying public. For example, before the airplane door can be closed and the plane can move, I must ensure that all carry-on baggage is properly stored and secured. The FAA requires that I make sure all galley supplies are secured for take-off and during landing. I must also check to see that all passengers two years old or older s are wearing a seatbelt for take-off, landing, while seated during flight or when the captain deems it necessary. In addition, flight attendants are required to be harnessed in their jumpseats for taxi, take-off and landing. The FAA requires these precautions to assure safe travel for passengers and crew. Yet, if we must make sure that food and beverage items are secure and baggage is properly stored, why do we allow children under two to sit unsecured on the laps of adult passengers? Even an onboard pet is safer in the protective confines of a required pet carrier.

Throughout my career, I have seen many parents with infants sitting unrestrained or loosely held on their laps. I have seen infants unrestrained in empty seats and children allowed to stand or toddle up and down the aisle during flight. Recently, I saw a three year old child sitting on her mother's lap as a "lap child." Three year olds are required to have their own seats. I have always been concerned that these unprotected children would be injured during unexpected turbulence and have studied the issue. I have learned that tests conducted at the FAA lab in Oklahoma City proved that in moderate to severe turbulence, a child's weight can multiply up to five times its normal weight. The tests' results indicate that it would be nearly impossible for an adult to hold a child against such G forces and these G forces are generally less than what would result in a crash.

In addition to these facts, all 50 states require child restraints for infants in cars. Cars generally travel between the speeds of 0 and 55 miles per hour. Airplanes travel at 500 miles an hour. While it is true that there have been few documented deaths of infants travelling on airplanes in their parents' laps, aren't "a few" deaths enough? This data does not include those children who are injured due to heavy turbulence each year. No statistics are recorded for infant injuries.

As I said earlier, over the past 13 years I have often worried about the infants on my flights who are not properly restrained. Yet, nothing could have prepared me for last July 19th. On that beautiful sunny day, I was enjoying a smooth flight and everything was under control. A momentary explosion turned serenity into disaster. After being informed by the captain that we would need to make an emergency landing, my flight attendant colleagues and I began preparing the cabin. We secured all baggage and food and beverage carts. As we approached Sioux City, we assisted passengers with infants on their laps. We instructed them to wrap their children in blankets and pillows, place them on the floor, assume a brace position over them and then hold the babies with all their might. Knowing what I did about G forces, I believed this was the safest way to secure babies absent child restraint seats.

Once the passenger preparation was completed, I harnessed myself in my jumpseat and waited for the brace signal. I mentally reviewed all that had been done. While thinking of the infants we had on board, I recalled an incident a month earlier when, in heavy turbulence, two infants were torn from their parents' arms and thrown through the air. Both infants were sent to the hospital for their injuries.

Within minutes we impacted, an impact that no words will ever adequately describe. Our world simply exploded in those few moments and I was knocked unconscious. It was a lifesaving blessing for me. When the plane stopped moving, I regained consciousness and evacuated passengers through a break in my section of the plane. I then exited as deadly smoke approached my position. Making my way through the cornfield, the first passenger I met was Sylvia Tsao, who was heading back towards the burning section. She told me she had to return to the plane to find her infant son. I restrained her from proceeding and told her someone would find her son. She turned to me and blurted out that I had told her to place her son on the floor and hold him. She had done that and now he was missing. I was overcome with the knowledge that I would live with those words for the rest of my life. Evan Tsao died in the crash.

I then saw Lori Michaelson in the cornfield. She was carrying her infant daughter Sabrina. When I asked her if she had been able to hold her daughter to the floor upon impact, she answered that she had not been able to hold her. Sabrina survived. The flight attendants on Flight 232 followed the prescribed procedures for protecting infants in an emergency situation. We did the best we could -- frustrated by the limitations -- and watched a parent grieve at the loss of her son and heard the miraculous story of Sabrina's recovery.

I will never forget that day in July. Each time I see parents holding their children on their laps on airplanes, I shudder. I believe that the only mistakes we make in life are the ones from which we learn nothing. We must learn from these mistakes. No parent or flight attendant should again be placed in this same situation. It is a tragic mistake to allow infants to travel by air unrestrained. Some say it will cost parents too much to pay for their infants to travel. If cost is the major concern, I think we are placing a price tag on a small child's head and engaging in a game of russian roulette. The airlines have the responsibility of transporting passengers safely. The FAA has the responsibility to mandate safety issues. Parents are responsible for their children and flight attendants are responsible for the safety of all passengers. No cost is too high if it means protecting infants from injury and possible death. We must require the use of child restraint seats for all infants. We must not wait for another statistic. The next one could be your own child.

Thank you again for this opportunity to appear before you today and talk about the need for child restraint seats. I urge your support of Representative Lightfoot's bill, H.R. 4025 and I urge the FAA to issue rules. I would be glad to answer any questions you may have.

STATEMENT OF RICHARD F. CHANDLER, (RETIRED), FORMER MANAGER OF THE PROTECTION AND SURVIVAL RESEARCH LABORATORY AT THE FAA CIVIL AEROMEDICAL INSTITUTE.

By way of introduction, in 1972 I was appointed to the position of Chief of the Protection and Survival Laboratory at the FAA Civil Aeromedical Laboratory in Oklahoma City. I remained in that position until my retirement in December of 1988. I would like to make it clear that my statement has not been reviewed by the FAA and does not necessarily represent their position. Moreover, I do not represent any particular organization in the matter of child restraint in aircraft.

The work of the Protection and Survival Laboratory included research in emergency evacuation, protective breathing equipment, water survival, seating and restraint systems, impact injury protection, and various measures of the population which could affect the performance of emergency equipment. This work has frequently been cited by the FAA when proposing improvements in airman or passenger safety. My own technical specialties are seating and restraint system performance and injury protection.

Shortly after taking the responsibility as manager of the Laboratory, we evaluated the crash protection provided by two designs of automobile child safety seats when used in passenger aircraft seats. As a result of these tests, I recommended (in 1972) that the two automobile child safety seats be accepted for use in civil passenger aircraft on an interim basis until a final regulatory position could be established. This was the first of several studies which we conducted to evaluate child protection systems for aircraft. Shortly before I retired, arrangements were made for a cooperative program with Transport Canada to evaluate the performance of an auxiliary child belt (a device suggested as an alternative to the automobile child seat which is in use by several foreign airlines) and of several new child seat designs. Throughout this rather long time period I have advocated the use of automobile child safety seats in aircraft as the best available means of protecting an infant or small child during an aircraft crash.

However, my advocacy of automobile child safety seats for use in aircraft has not been without reservation. There are factors, both technological and operational, which I believe should be considered before mandating the use of special restraints for children traveling in transport airplanes. I would like to discuss some of these factors at this time.

Let us first consider some of the technological problems. There are no satisfactory infant or child restraint systems designed specifically for use in aircraft. The auxiliary child belt, previously mentioned, is a means of restraining lap-held children in aircraft. Unfortunately, the auxiliary child belt concentrates crash forces on the child's abdomen, and places the child in a position to act as a "crash pad" for the adult during a crash. Consequently, use of the auxiliary belt is likely to cause serious and nonreversible injury to the child. While it has been suggested that the auxiliary child belt may be of value during severe turbulence (if it is properly fastened), the concentration of force on the child's abdomen and the minimal restraint offered to the child's movement limits its usefulness in any severe dynamic environment. The remaining justification for the auxiliary child belt is that it would prevent the child from becoming a "missile" and injuring another passenger. Yet, reports of injuries from this source are very rare. Other types of infant restraint, such as bassinets which could be attached to a bulkhead, were briefly considered in the early 1960's but were never accepted for use during landing and takeoff.

Automobile safety seats for children have received extensive development and distribution as a result of state mandates for their use in automobiles. These seats have been considered acceptable for use on aircraft since 1982, but were not required. They are the most highly developed devices available for protecting infants and small children from crash injuries. However, they are designed primarily for the automobile environment, and not for the different aircraft environment.

Some of these differences were recognized from the onset. The Motor Vehicle Safety Standard was modified in 1985 to include a simple inversion test in an attempt to provide for the turbulent conditions encountered in aircraft. But no changes were made to account for the "breakover" seat back feature found in many aircraft seats. A child in some automobile safety seats could be caught between the seat back and the seat, and possibly injured.

Other technical problems are surfacing as we gain more experience with automobile child safety seats in aircraft. Some child seats are so big that they will not fit in some aircraft seats. The aircraft seat belt is sometimes difficult to fasten around the child safety seat, and once fastened and properly adjusted, it is even more difficult to release. Some child seats install so that the adjustor of the aircraft seat belt is positioned so as to allow the belt to extend under load. The location of the aircraft seat belt is different than many automobile seat belts, and this difference in location can cause premature failure of some automobile child safety seats. Some automobile child safety seats, primarily those called "booster seats," could place the child in an aircraft seat so that the risk of injury is greater than if the child had used only the aircraft seat belt. These, and other problems, are currently being addressed by a special joint committee of automobile and aircraft specialists, formed by the Society of Automotive Engineers at the instigation of the Air Transport Association. This committee has just begun its work, with the second meeting scheduled for the week of July 16, 1990. The efforts of this committee are likely to lead to additional requirements for both child seats and aircraft passenger seats.

These problems should be resolved by minor design changes in the child seats and passenger seats. A more serious technical problem is the possible incompatibility of some automobile child safety seats with the new "16 g" aircraft seats being installed by the airlines. Most of these seats are designed to be "energy absorbing." This means that the seats will bend when exposed to high crash loads, rather than remain stiff and break. Current guidelines indicate that these new seats could bend and rotate up to 20 degrees during the crash. A child safety seat installed in these seats would rotate more than 20 degrees as the seat cushion deflects and the aircraft seat belt becomes tight. If this total rotation is excessive, the child could be thrown from the seat. Work to evaluate and resolve this problem has not yet begun.

I have mentioned these technological problems to illustrate that, while automobile child seats are currently the best available means of providing crash protection for small children in aircraft, they are presently not an optimum solution. The publicity following the recent Sioux City crash has generated interest in the design of child restraint systems for aircraft, and many concepts are being proposed. Work is also being done, internationally, to develop a replacement for the (inadequate and dangerous) auxiliary child belt for the lap-held child. These efforts will provide an up-to-date technological reassessment of the problem of restraining small children during emergencies on transport airplanes. A premature requirement for special child restraint in aircraft could have the effect of freezing the state-of-the-art at the existing level of technology, and thus preclude consideration of new concepts which may be forthcoming.

However, the major problem with our present child safety seats is not a technological problem, but the fact that they require a vacant adult seat for their installation. If child seats were used for all lap-held children currently flying on transport aircraft, the value of the adult seats required would be approximately one quarter of a billion dollars annually (assuming that the child rate would be half fare, and that lap-held children comprise about 1% of the passengers).

Studies which show a positive benefit for the use of child safety seats in aircraft typically assume that, somehow, there would be no charge for these seats, even if their use was mandatory. However, I believe that, in our society, it is unreasonable to mandate that a service be provided without expecting that those providing the service will be compensated for that service. While many of our airlines have indicated that they are currently willing to accept child safety seats without charge on a space-available basis, they also emphasize that the only way to assure the acceptance of the child seat is to purchase the adult seat in which it will be used. I cannot believe that an unregulated and profit conscious airline industry would permanently reject the opportunity for an additional one-quarter billion dollars of annual passenger revenue which could result from the mandatory use of child safety seats. Furthermore, it is likely that the airlines would also provide the mandated child safety seats for use in their aircraft, and would make appropriate additional charges for this service. Passenger provided child safety seats would then be treated as baggage and not used during the flight.

Unfortunately, we cannot make an accurate prediction of the ultimate result of these actions. In its Notice of Proposed Rulemaking on March 1, 1990, the FAA estimated that the families of 700,000 children would refrain from flying each year because of the cost of mandating the use of child safety seats for children under 2 years of age. If one assumes that most family travel with children is for pleasure purposes rather than for business, it is likely that many of the families who reject air travel because of cost will use alternate means, such as travel by automobile, for these pleasure trips. This will expose those families to the risks of death and injury associated with automobile travel. If even one life is lost annually in this highway travel, it would nullify the overall benefits of using child safety seats in aircraft.[See Note]

The potential widespread use of child seats provided by airlines rather than by parents also has risk. In our research, and in accident studies, we have found that misunderstanding or misuse of safety equipment is not uncommon, even if "one-on-one" instruction has been provided. I believe that this is due largely to the lack of opportunity to practice the emergency or learn the use of the equipment through repetitive trials. I have always been concerned that the difficulty in removing a child from a safety seat in the highly stressful post-crash environment could delay the emergency evacuation of the child, the parent, and perhaps even other passengers. A few seconds or minutes of delay could prove fatal to these people if the aircraft was burning. Familiarity with the child safety seat through long use of the seat in the family automobile should minimize this risk. However, if the child safety seat was supplied by the airline, and particularly if it differed significantly from the seat used in the family automobile, I would expect that the risk would be real. Although there are presently no data which could lead to quantification of this risk, we must remember that the loss of even one life per year from this risk could negate the advantages of mandating the use of child safety seats in transport aircraft.

In conclusion, I would like to mention one of the principles of problem solving which is sometimes overlooked: The solution to the problem should not generate problems greater than that being solved. Since the benefit to be gained through the mandatory use of special child restraints is very small, that benefit could easily be nullified or even become negative by the risks I have outlined. Unfortunately, there are no data which would produce a confident estimate of the risks or advantages. In such a situation, technology falls short of providing answers, and decisions must be made on the basis of informed judgement.

I wish to thank the committee for the opportunity to present my opinions on this matter. The problems of improving protection for children traveling on transport aircraft are complex, and I have only touched on a few of the factors in my written statement. I would be pleased to answer questions or offer my assistance in resolving this complex issue.

Note: One of the few scientific studies of the risk of children in transport aircraft was authored by Fife, et al., (AJPH, Vol. 71, No. 11, pp. 1242-1246, November 1981). This study examined transport aircraft accidents from 1976 through 1979. One conclusion was that if infant restraints could reduce the infant risk to the level of the adult risk, then 0.6 infant lives per year or three lives in five years could be saved. While non-survivable crashes were excluded from the study, data from crashes in which certain areas of the cabin were non-survivable were included. If it is acknowledged that infant restraints would not be effective in those cabin areas, the number of lives which could be saved would decline to only 0.2 lives per year, or one life every five years. If infant restraints were used on a voluntary basis, the advantage provided by mandatory infant restraints (for the remainder of the children) would be even lower.

STATEMENT OF WALTER S. COLEMAN
VICE PRESIDENT, OPERATIONS
AIR TRANSPORT ASSOCIATION OF AMERICA
BEFORE THE HOUSE PUBLIC WORKS & TRANSPORTATION COMMITTEE
SUBCOMMITTEE ON AVIATION
ON CHILD SAFETY RESTRAINTS
July 12, 1990

Good afternoon, I am Walter S. Coleman, Vice President, Operations of the Air Transport Association of America. ATA represents 20 U.S. airlines, 17 of which carry passengers. The ATA appreciates the opportunity to appear today to discuss the important issue of child safety restraints. The ATA would also like to recognize and commend the leadership of Congressman Lightfoot and his colleagues who have cosponsored legislation on this important safety issue. We support H.R. 4025.

All aspects of airline flight operations are under constant examination with an objective of improving safety. The majority of this scrutiny comes from individual airlines who review their own and the industry's efforts and successes in achieving the highest level of safety. The ATA member airlines' decision to seek a change in the regulation to prohibit infants under the age of two years old to travel without being restrained is an example of our quest for increased safety for the air traveling public.

The Air Transport Association, on behalf of its member airlines, filed a petition on February 22, 1990, which, if it were to become a rule, would require that all passengers be restrained during takeoff, landing and when directed by the captain. The single purpose of the petition is to remove the language in the Federal Aviation Regulations which requires a restraint for passengers who have reached their second birthday and which effectively results in many children under the age of two traveling in the arms of an adult. The arms of an adult are not a satisfactory safety restraint in an airline cabin.

There is little doubt that the Sioux City DC-10 accident in the summer of 1989 provided the stimulus for the airline industry to consider, then file our petition. The Sioux City accident was unique in that the cockpit and cabin crew had time to prepare for an anticipated emergency. They expected an abnormal landing which could result in injuries and even loss of life. In compliance with FAA regulations, the flight attendants prepared the cabin for the emergency landing by storing or restraining all loose items in the cabin. Everything in the cabin was restrained except for the three infants traveling in the arms of adults. The ATA petition, if it were to become a regulation, would not permit this circumstance to occur again.

There are some who believe it has taken too long to decide that infants should be restrained when traveling on an airliner. Perhaps it has taken too long. However it was not so long ago that automobile occupants were not required to wear seat belts.

Similarly it has only been since 1985 that all 50 states required that small children traveling in automobiles travel in car safety seats. While the public's interest in the issue of protecting infants when traveling on airliners would have come about without the Sioux City tragedy, the Sioux City accident clearly accelerated the actions that are now taking place.

FAA staff has been working on child safety restraints for airplanes since the 1960s. Some restraints were approved for use in aircraft in the early 1980s and a subsequent labeling requirement to make it easier for both consumers and airline personnel to identify restraints approved for use both in aircraft and in automobiles was begun in 1985. Over the years, the traveling public's acceptance of seat belts in airplanes, seat belts and shoulder harnesses in automobiles and child safety restraints in cars have all brought us to the point where it is both necessary and inevitable that we require safety restraints for infants on airplanes.

As we noted earlier, all loose items in an airline cabin are stowed prior to takeoff and landing. Infants, held in the arms of their accompanying adult, are the sole exception. The permissive language which does not require infants under the age of two to be restrained can be found in the regulations of 40 years ago. The 1953 Civil Air Regulation Part 40.174 states that a "A seat and an individual safety belt are required for each passenger and crew member, excluding infants,..." This regulatory requirement is not particularly surprising. Seat belts on airplanes have not changed significantly in the last 40 years. A small infant who cannot support his or her head in an upright position and whose body structure has not matured enough to effectively be protected by a passenger safety belt should not be strapped into a passenger seat with a standard adult safety belt.

However, child safety restraints that were not available 40 years ago are available now, and they have been approved by the regulatory authorities. We think that if child safety seats such as we now have would have been available at the beginning of commercial aviation, they would have been identified as the appropriate protection for infants traveling by air and would be a familiar and accepted part of air travel. Now that these seats are available, we should provide the maximum protection for infants when they travel by making the use of some sort of child safety restraint mandatory.

In the fall of 1989, before ATA member airlines began to consider a petition to change the rule, an airline industry group led by ATA visited the FAA Civil Aeromedical Institute (CAMI) in Oklahoma City to review cabin safety Research and Development programs. Subsequently, ATA sent a letter to the FAA commending CAMI on their research and recommending that CAMI continue research on new and innovative approaches on infant protection. We also asked for additional emphasis on alternatives to infant protection that would not require the use of a dedicated passenger seat.

In the fall of 1989, ATA established an Infant/Child Safety Restraint Task Force with several specific objectives. One of the primary objectives of this task force is to amend the child safety seat standard to provide a seat more suitable for use on transport aircraft. Child safety seats are designed to be installed in relatively roomy automobile seating areas and perhaps left installed until the child outgrows the seat. The use of child safety seats on airlines is very different. Airline seats do not provide the same space which is available in most auto interiors and the safety seat may be installed for a very short period, then removed to be installed again, perhaps in another airplane. Thus the airline industry envisions the development of child safety seat which would be light in weight, narrow enough to fit into an airline seat and would also be easily installed.

We also continue to seek the development of a safety restraint alternative that does not use a passenger seat. Obviously we would want the child to be seated with the accompanying adult and the area in front of the adult passenger is a likely area for a safety restraint, however, we are unaware of any designs which can be approved at this time. Therefore, we continue to encourage research in this area by encouraging both FAA in their efforts at CAMI and by encouraging individuals, inventors and entrepreneurs, who have contacted ATA since the issue arose, to propose solutions.

In February, 1990 ATA hosted a Child Restraint Conference. Attendees included ATA airlines, representatives from FAA Flight Standards, FAA CAMI representatives, National Highway Traffic Safety Administration, National Transportation Safety Board, American Academy of Pediatrics, Aerospace Industries Association, Association of Flight Attendants, manufacturers of cnild safety seats and university researchers. It was the first time that all the parties who are involved in child safety restraint used in airliners had gathered together and the result of the conference was a decision to form a committee under the auspices of a Society of Automotive Engineers Aerospace committee which would combine both the aviation and automobile expertise on child safety restraints. This committee has met once and will meet again in a few weeks. It is expected to provide recommendations for modifying the standards for automobile safety restraints to make them more useful, effective and adaptable to use in an airline cabin.

A fundamental part of the discussion of requiring the mandatory use of child safety restraints is the issue of cost. Since an infant, who is not yet two years old presently travels at no cost, will a charge for a seat to be occupied by an infant cause the accompanying adult or adults to choose not to travel by air? If that is true, what is the net safety outcome if the family unit elects to travel by automobile? Auto travel is less safe than air travel. There are few infant fatalities in air travel because there are few fatal air carrier accidents and, if many travelers chose not to fly and went by automobile instead, the result could be a net increase in infant (and adult) fatalities, however we believe that these potential airline passengers are still going to choose to fly. We believe they will continue to choose to fly because the airlines, rather than risk the loss of one or more adult fares or perhaps an entire family unit, will offer a fare arrangement acceptable even for families traveling with infants who previously would have flown free.

Mr. Chairman, the airlines have a responsibility to transport their passengers safely. We want people to fly. We fully anticipate that the marketplace will create a competitive climate that will continue to attract adults traveling with infants. It is not in our interest to discourage potential customers from flying.

There is an additional item worth mentioning. In March we were notified that the United Kingdom Civil Aviation Authority (CAA) was permitting use of both CAA and U.S. FAA approved child safety restraints. At the present time, only U.S. NHTSA approved and appropriately marked child safety restraints are accepted on U.S. airlines. ATA has asked FAA to approve the use of CAA approved restraints on U.S. airlines. FAA responded by letter stating its intention to cooperate fully with the CAA and others in "achieving international consensus and common child restraint criteria." We are pleased with that answer and the stated intention of the FAA.

While certainly no one likes to contemplate the prospect of air travel emergencies, it is the airlines' responsibility to do so. Recently several important safety improvements on airliners have been introduced to increase survivability in the event of an emergency: Fire blocking seats, fire resistant interior cabin materials, lavatory smoke detectors and the 16 g seat are some of them. Child safety restraints should be added to that list.

That completes my statement and I would be pleased to answer any questions.

National Transportation Safety Board
Washington, D.C. 20594

Safety Information

Testimony of
Susan M. Coughlin, Vice Chairman
National Transportation Safety Board
before the
Subcommittee on Aviation
Committee on Public Works and Transportation
House of Representatives
Regarding
Aircraft Child Restraints

July 12, 1990

In post-impact evacuation, survivability depends on a person having enough time and the means to escape from the airplane -- which may become a very hostile environment.

The FAA has been very active in the development of regulations, advisory circulars, and technical standard orders (TSO) to improve occupant protection and increase cabin safety. In the past five years we have seen improvements in seat strength, seat cushion fire blocking, floor proximity lighting, access to exits, carry-on baggage programs, and crewmember emergency training. In a 1988 Notice of Proposed Rulemaking on "Improved Survival Equipment for Inadvertent Water Landings," the FAA even proposed a requirement for "an approved life preserver for each infant and child." To fail to require infant and child restraints during takeoff, landing, and when seatbelt signs are lit represents an inconsistency that should be corrected.

The FAA currently requires that all occupants be restrained for takeoff, landing, and turbulent conditions -- with the exception of occupants who have not reached their second birthday, who may be held in the arms of an adult. The Safety Board believes the FAA's decision to allow this is a contradiction of basic safety practices.

The FAA first allowed the use of child restraints in 1982.[4] In 1985, the FAA adopted a TSO that allowed the use of child restraints that were manufactured after 1985 and met certain standards. This, however, has not resulted in the widespread use of child restraints on aircraft as we had hoped. Some reasons for the lack of voluntary compliance may be that parents are unaware that they are allowed to use a child restraint; that they choose to hold the child as opposed to paying for an additional seat; or that they receive conflicting information from flight attendants regarding use of child restraints on takeoff and landing.

Based on our accident investigation experience, the Safety Board does not believe that there has been a significant increase in the use of child safety seats since 1985. The Safety Board knows of no fatal air carrier accident in which any child was using an FAA approved child restraint device. According to testimony presented by the Air Transport Association at our hearing on the July 19, 1989, DC-10 accident in Sioux City, Iowa, the use of child restraints is not even common among children over two years old, who are required to purchase a ticket for their flight. Indeed, half of all four year old children weigh less than the 40 pound limit in our safety recommendations.

Children held in the laps of adults are not being offered the same level of protection from injury as restrained occupants, and unrestrained infants expose others to risk as well. The tremendous forces at impact are simply too great for children to be held securely by their parents. They can, probably will, be injured as they are tossed about the cabin, and their parents may not be able to find them in time to evacuate safely. An unrestrained object in the cabin can strike and injure occupants[1], and possibly prevent or slow their escape. In contrast, passengers are not allowed to hold on their laps briefcases, that weigh much less than an infant, or to place them at their feet during takeoff and landing (instead of underneath the seat in front) because they represent a danger to the other occupants.

The Sioux City accident clearly illustrates several problems relating to infant/child restraint. The airplane crashed during an attempted emergency landing at Sioux City Gateway Airport. During the ground impact sequence, the airplane separated into sections, some of which burned. Of the 296 persons on board, 110 passengers and a flight attendant were fatally injured.

The Safety Board's continuing investigation of this accident has disclosed problems that affected the safety and survivability of infants and small children on board the aircraft. Among the 285 passengers were 3 infants and 1 small child -- ranging in age from 11 months to 26 months -- who were being held by adults. One infant was fatally injured, and the other two infants and the small child sustained minor injuries.

As part of the preparation for the emergency landing, parents were instructed to place their "infants" on the floor and to hold them there when the parent assumed the protective brace position. The four "in-lap occupants" were held on the floor by adults who occupied seats 11F, 12B, 14J, and 22E. Investigators do not know what happened to the 26-month-old child at 12B during the impact sequence; however, the child did sustain an abrasion to his left hand and his father was not injured. The 11-month-old infant at seat 11F was pulled from her mother's grasp during the impact, and the parents were unable to find her when the airplane stopped. She was found by a passenger who re-entered the burning cabin when he heard a baby crying. The infant sustained an abrasion under her left eye; the mother was not injured.

The woman in 14J said there were two extremely hard impacts before the airplane rolled to the right. She stated, "My son flew up in the air and I managed to grab hold of him around the waist. He struck his head [on the side of the cabin wall] several times before the plane came to a stop and several times I had to pull him back into my arms as he slid out of my grip." Her 23-month-old son sustained a scalp contusion.

The woman seated in 22E stated that she assumed the brace position with her 23-month-old son on the floor between her legs. During the impact, she was jolted to an upright position and she saw her son's body "flying" down the right aisle toward the rear of the cabin. When the airplane stopped, she could not get to the back of the cabin where she thought her son was. Smoke immediately entered the cabin and hindered her breathing; she was urged by other passengers to exit. She was not injured, but her son died of asphyxia secondary to smoke inhalation.

The problems experienced by the three parents in the Sioux City accident graphically illustrate the impossibility of holding onto an infant during a crash, even though the parents were using one of several "brace-for-impact" position approved by the FAA. A witness for the Air Transport Association testified at the Safety Board's hearing on the Sioux City accident that there were numerous "brace-for-impact" positions recommended by the airlines for adults travelling with in-lap children. Some air carriers show these positions on their briefing cards, while others only explain them when preparing the cabin for an emergency landing. Researchers at the FAA's Civil Aeromedical Institute have vividly demonstrated, with dummies of varying weights, that holding onto an infant is difficult, even in aircraft accidents involving the minor inertial loads specified by the FAA in 14 CFR 25.561.

There was also confusion among some passengers during the preparation for the emergency landing at Sioux City about which "infants" to place on the floor. The passenger in seat 17E stated that the woman next to him apparently considered, but then rejected, taking her 27-month-old son out of his seat (seat 17G) where he was secured by a lapbelt to place him on the floor in response to instructions given over the public address system. The 27-month-old boy remained secured in seat 17G by the lapbelt during the impact and was not injured. A 3-year-old girl was taken from seat 27D by her father who was in seat 27C and placed on the floor. Both the father and daughter died of smoke inhalation.

The additional problem of identifying the age of in-lap children was illustrated by the "in-lap" 26-month-old child travelling with his father seated in 12B. By regulation, that child should have been restrained in a separate seat.

The Safety Board is concerned that federal regulations do not yet adequately address the issue of "infant" occupant protection. Investigations of other accidents have repeatedly shown problems with the safety and survivability of unrestrained infants and small children who have been involved in survivable crashes.

A 1978 DC-8 accident in Portland, Oregon, prompted the Safety Board to issue its first recommendation to the FAA regarding infant restraint. There were six infants and six small children onboard and two infants and one child were killed. As a result of its investigation of the accident the Safety

Board issued a recommendation to the FAA to expedite research with a view toward early rulemaking on a means to most effectively restrain infants and small children during in-flight upsets and survivable crash landings. The FAA issued a TSO in 1982 that provided for the use of some automobile infant restraint devices on airplanes.

In 1983, the Safety Board urged the FAA to amend the TSO to permit the use of infant restraint devices that conformed to the National Highway Traffic Safety Administration (NHTSA) standards so that parents would be able to use the same device on the airplane that they used in their automobile. The NHTSA standards were eventually modified and in 1985 the FAA issued a new TSO that permitted child restraint devices manufactured after February 26, 1985, and that also complied with applicable NHTSA standards, to be used onboard aircraft.

The Safety Board investigated a DC-9 accident in Denver, Colorado on November 15, 1987, in which a 6-month-old infant was one of the 25 passengers killed. His mother, who had been holding him for takeoff, was one of the 52 passengers who survived.

The Safety Board is currently investigating a B-707 Avianca Airlines accident that occurred in Cove Neck, New York, on January 25, 1990. There were 149 passengers and 9 crewmembers, including 7 infants under 2 years old. A 4-month-old infant was one of 64 passengers who sustained fatal injuries; his mother survived with serious injuries. The six other infants, between the ages of 4 and 18 months, sustained serious injuries.

Another problem for unrestrained occupants are turbulence encounters. Investigations have revealed infants who were injured during turbulence. Below are examples for your information.

-- January 4, 1972 -- A 6-month-old infant struck the overhead compartment and sustained a facial contusion when a Boeing 747 encountered in flight turbulence.

-- July 13, 1986 -- During its descent for landing in Miami, Florida, an Airbus A-300 encountered turbulence, and a 7-month-old infant was propelled upward and fell onto a seat in the row in front of his parents, sustaining a minor injury.

-- June 6, 1989 -- Enroute from Los Angeles to Chicago, the captain of a DC-10 instructed passengers and flight attendants to fasten their seatbelts in preparation for expected turbulence. When they encountered turbulence, a 4-month-old baby was pulled from his mother's arms, fell to the floor, and was buried under a pile of garment bags that fell out of a closet in front of their seat. He sustained minor injuries.

-- January 20, 1990 -- a 7-week-old infant sustained a serious head injury when a DC-10 encountered turbulence near San Juan. He was the only occupant to receive serious injuries.

In testimony at the Safety Board's accident investigation hearing last October in Sioux City, Iowa, an FAA witness was asked to identify the best way for parents to protect their infants. The witness stated that infants are best protected in "an FAA-approved infant/child restraint system that was properly installed in a seat." The Safety Board completely agrees with this statement and urges the FAA to make it a requirement. Voluntary compliance has not resulted in increased protection for children under 2 years old. The FAA also stated that a review of regulatory history has failed to identify the reason for permitting occupants who have not reached their second birthday to be held in the lap of an adult. The FAA's selection of 2-years-old as the age cutoff for the requirement for occupant restraint is, therefore, not based on scientific or empirical data.

On May 30, 1990, the Safety Board recommended that the FAA revise regulations to require that all aircraft occupants be restrained during takeoff, landing, and turbulent conditions, and that infants and small children under the weight of 40 pounds and less than 40 inches high be restrained in an approved child restraint system appropriate to their size. This recommendation protects not only children under 2 years of age who now are not covered by any occupant restraint requirements, but also affords children over the age of 2 and less than 40 pounds and 40 inches tall who are currently required to be restrained in an aircraft seatbelt, the additional protection of a child restraint. The Safety Board also recommended that the FAA conduct research to determine the adequacy of aircraft seatbelts to restrain children too large to use child safety seats and to develop a suitable means of providing adequate restraint for such children.

In conclusion, the Safety Board believes that unrestrained infants and small children are not being offered the same level of protection as other occupants on an airplane, and that these unrestrained infants and children expose other occupants in the cabin to increased risk of injury. The Safety Board believes that the FAA's policy of voluntary use of child restraints has been ineffective and that the time has come to ensure that all occupants are afforded an equal level of safety.

Mr. Chairman, that concludes my formal statement. I will be pleased to respond to any question that you may have.

Mr. Chairman and Members of the Committee, I want to thank you for this opportunity to present the views of the National Transportation Safety Board concerning child restraints on aircraft. The Safety Board shares your concerns about protecting infants and small children aboard aircraft, and we look forward to early implementation of regulations that will require children to occupy approved restraint devices.

Before I relate the accident investigation history that led to our recent Safety Recommendation letter to the Federal Aviation Administration (FAA) regarding child restraints on aircraft, I would like to briefly discuss occupant survivability and improvements made over the past five years, and the Safety Board's concerns with allowing unrestrained occupants aboard airplanes.

In general, crash survivability requires that during the crash impact the following conditions be met:

-- the inertial forces do not exceed human tolerance, generally accepted at 20 Gs;

-- the seat remain fastened to its floor/wall attachments; and the occupant remain in the seat;

-- the seat and its restraint system retain their structural integrity; and

-- the "livable space" around the person is maintained.

CEI

COMPETITIVE ENTERPRISE INSTITUTE

TESTIMONY OF THE COMPETITIVE ENTERPRISE INSTITUTE AND CONSUMER ALERT TO THE AVIATION SUBCOMMITTEE OF THE HOUSE COMMITTEE ON PUBLIC WORKS AND TRANSPORTATION ON THE ISSUE OF MANDATORY AIRLINE CHILD SEATS

The Competitive Enterprise Institute and Consumer Alert appreciate this opportunity to present their views on the question of whether child seats should be mandated on airlines. For the reasons described below (and set forth in our submissions to the Federal Aviation Authority, Dockets 26142 and 26143), we oppose any requirement of child seats for infants and young children who are currently permitted to ride on their parents' laps in airplanes. Such a mandate would be a totally unwarranted restriction on consumer choice. While this proposal is allegedly justified on grounds of safety, in reality it would force families into far more dangerous modes of travel. Its end result would be deaths and injuries on our highways that would greatly overshadow the limited and speculative safety benefits that it might produce in the air.

CEI is a nonprofit organization engaged in promoting free-market approaches to regulatory issues. CEI is involved in analysis, education and advocacy on a number of public interest subjects in the area of transportation and safety.

Consumer Alert is a nonprofit organization with over 6,000 individual and family members in the United States. Consumer Alert is engaged in defending and expanding consumer choice in the marketplace, and in increasing public awareness of the hidden costs of unwarranted government regulation.

233 PENNSYLVANIA AVE., S.E. • SUITE 200 • WASHINGTON, D.C. 20003 • (202) 547-1010

One example of the safety work of CEI and Consumer Alert is their joint project on the negative effects of federal auto fuel economy standards on automobile crashworthiness. See, e.g., CEI and Consumer Alert v. National Highway Traffic Safety Administration, __ F.2d __, (D.C. Cir. No. 86-1646, decided Jan. 19, 1990). This previously unrecognized issue has now become the subject of a number of academic and agency studies.

The practical result of a mandatory child seat rule would be that families would now have to purchase tickets for children who previously rode free. FAA recognizes the huge financial impact of such a rule. According to the agency, it would cost consumers over $210,000,000 annually and would result in a 21 percent reduction in airline trips by such families. 55 Fed. Reg. 7414, 7416 (Mar. 1, 1990). However, FAA has identified only eight commercial airline accidents over the past 15 years in which such restraints might have reduced casualties. Id. at 7415.

Other commenters agree that the number of deaths and injuries which might be prevented by a child seat rule is extremely small.[1] Thus, on a cost-benefit basis alone, such a rule would be totally unwarranted.

More importantly, a child seat rule would in all likelihood result in a net loss of life. Of the 700,000 families who, according to FAA, would be dissuaded from flying each year due the cost of children's tickets under this rule, a large number would make their trips by automobile instead. However, an unrestrained child sitting on a parent's lap in a plane is far safer than a restrained child traveling by car. As the attached analyses by Professors Richard B. McKenzie, Dwight R. Lee, and John T. Warner indicate, the substitution of automobile travel for airline travel is deadly. They estimate that a requirement of child seats on airlines would lead to 5 deaths and over 175 disabling injuries on our roads annually, far outnumbering the few deaths and injuries that such a mandate might prevent in the air. What the public would receive for its $210 million annual expenditure would be less safety, not more.[2]

---

[1] In its petition to FAA, the Air Transport Association (ATA) cites a Harvard Medical School study that found that airline child restraints would save less than one life per year. ATA Petition at 4. ATA itself characterizes the rule's safety benefit as "very modest". Id. at 5. Similarly, a spokesman for the American Academy of Pediatrics Committee on Accident and Poison Prevention stated that

> "air safety authorities estimate that each year in the United States only one-to-three fatalities and 10-to-30 significant injuries occur to children under five years of age due to 'survivable' crashes of major airline carriers ...." Id. at Attachment E.

Several proponents of the child seat rule have argued that the overall highway fatality rate used by Professors Richard McKenzie and Dwight Lee overstates the accident exposure of parents who would drive rather than fly under such a rule. They argue that these parents would drive especially carefully because their young children would be accompanying them in their cars.

Such an attempt to categorize the driving habits of these families is extremely speculative. We can only guess at the kinds of roads they will travel on, the time of day that they will be driving, and how tired they may be during the lengthy rides that would typically substitute for air travel. However, even if one accepts this dubious approach, a recent study indicates that even the very safest drivers are still generally at greater risk on the road than in an airplane. L. Evans, M.C. Frick & R.C. Schwing, Is It Safer To

---

[2] The McKenzie-Lee conclusion regarding 175 disabling highway injuries is especially important. There is a high ratio of injuries to deaths on the highways (70 to 1; see Evans, supra, at 13), but the ratio for airlines is very low (less than one). Thus, even if one views the fatalities at risk under this rule as being approximately equal (though they are not), it is clear that the added highway injuries would far overwhelm any injury savings in the air.

Fly Or Drive?--A Problem In Risk Communication (General Motors Research Laboratories, GMR-6722, June 19, 1989) (attached hereto).[3] In the words of this study, the "driving fatality risk for [a] 'low risk' driver is ... 43% higher than the [risk] of airline travel." Id. at 10.

The low-risk driver in this study is a 40-year old, alcohol-free belted driver in a heavier than average car on a rural Interstate road. There is no reason to assume that young families would be at this low a risk. The average age of parents with children under two is probably under 30 years.[4] The youngest of these parents, moreover, would probably be most sensitive to price increases in air fares. Thus, the average age of parents engaging in substitute driving under a child seat mandate would be even lower.

There is also a basic issue of consumer choice that is at risk here. Those consumers who wish to fly with their children protected by child restraints currently can do so--they need only buy tickets for their children to assure that there are seats for them.[5] Other consumers can choose to fly with their children riding on their laps.

---

[3] This study has also just been published in 10 Risk Analysis 239-246 (1990).

[4] The average age of mothers who gave birth in the last year is approximately 26.5. See Statistical Abstract of the United States at 63 (107th ed. 1985). The average age of mothers who gave birth in either of the last two years is thus about 27. Since grooms are generally 3 years older than brides, one can assume that fathers of these children are about 30 years old on average.

[5] Consumer Alert and CEI support the removal of all regulatory barriers that currently impede consumers in using their own child restraints on airplanes.

Absent some compelling reason, government should abstain from restricting this existing freedom of choice. As shown above, there is no justification for a child seat mandate, and the requirement itself would waste both lives and money.

Respectfully submitted,

SAM KAZMAN
Competitive Enterprise Institute
233 Pennsylvania Ave. S.E.
Suite 200
Washington D.C. 20003

July 12, 1990

attachments:

- R. McKenzie & D. Lee, Ending The Free Ride Of Children On Airplanes: A Short-Sighted Method Of Saving Infants' Lives (May, 1990);
- R. McKenzie & J. Warner, The Impact Of Airline Deregulation On Highway Safety (Dec. 1987);
- L. Evans, M.C. Frick & R.C. Schwing, Is It Safer To Fly Or Drive?--A Problem In Risk Communication (General Motors Research Laboratories, GMR-6722, June 19, 1989).

ENDING THE FREE RIDE OF CHILDREN ON AIRPLANES: A SHORT-SIGHTED METHOD OF SAVING INFANTS' LIVES

Richard B. McKenzie
Dwight R. Lee[1]

Currently, parents can buy airline tickets for themselves and hold their infants and toddlers under two years of age on their laps during flights. Under the banner of saving children's lives in air accidents, the Los Angeles Area Child Passenger Safety Association has petitioned the Federal Aviation Administration to end the free ride of infants by requiring the use of child-restraint systems in paid seats.[2]

In case the FAA resists changing its seating rules, Representative Jim Lightfoot (R-Iowa) and Senator Kit Bond (R-Missouri) have introduced legislation to mandate the use of safety seats by infants and toddlers on airplanes.[3] Congressmen Lightfoot was spurred to introduce his bill by the death of two infants in the crash of United Airline flight 232 in Sioux City, Iowa last July. He reasons that rules requiring the use of safety seats in automobiles should be extended to airlines because "the potential for injury in an aircraft flying at 550 miles per hour is much greater than the potential for injury in an automobile traveling at 50 miles per hour."[4]

---

[1] The authors are adjunct fellows at the Center for the Study of American Business at Washington University in St. Louis. Mr. McKenzie is professor of economics and finance at the University of Mississippi, and Mr. Lee is professor of economics at the University of Georgia.

[2] Federal Aviation Administration, U.S. Department of Transportation, Miscellaneous Operation Amendments, Federal Register (March 1, 1990), pp. 7414-7421.

[3] See House, U.S. Congress, 101st Cong., 2d Sess., A Bill to Amend the Federal Aviation Act of 1958 to Require the Use of Child Safety Restraint Systems Approved by the Secretary of Transportation on Commercial Aircraft (H.R. 4025).

Representative Lightfoot maintains that his proposal does not mandate the purchase of additional seats, only the use of safety seats by infants. He reasons that parents can use their safety seats required for automobiles, which have also been approved for air travel, and can continue to use free empty airline seats, as they now do. However, the safety seat rule would have the effect of requiring parents to buy additional airline seats for their infants and to rent child-restraint systems, if they do not have one of their own available. Very few parents would buy their own tickets -- especially the cheaper advanced tickets that are nonrefundable -- and take the risk of not being able to board at the last minute because adjoining seats are unavailable.

The FAA, the 50 or so members of Congress, and everyone else who support the rule change are rightfully concerned with the safety of traveling children. However, what child-safety advocates and the FAA have not yet considered is that the proposal, if adopted, could have precisely the opposite effect of the one intended: The rule change could increase the travel injuries and deaths of infants and toddlers -- and their parents and siblings.

These perverse results would likely occur because the rule change would drive up the cost of travel by air and drive many families back to the nation's highways. And car travel remains far more dangerous, at least 30 times more so in terms of death-rate per mile traveled, for all travelers -- parents and children alike -- than air travel by all scheduled (large and commuter) airlines.

---

[4] Jim Lightfoot, "The Need for Child Safety Restraints aboard Aircraft," Congressional Record (February 27, 1990).

Nearly 1,200 children under five years of age were killed in automobile accidents in 1988.[5] That means that at least twice as many automotive deaths of very young children in 1988 than there were total deaths of children and adults on scheduled airlines over the previous five years.

According to the FAA's own (admittedly rough) calculations, mandated seats for infants could increase the average air-travel cost of a family of four (two parents with one child over three and one infant) by at least 21 percent -- assuming that airlines charge only half fares for infants. That cost increase could reduce the boardings of infants by about 18 percent, or 700,000, again according to FAA estimates. Many of the families who could no longer afford air travel can be expected to complete many, but not all, of their travel plans by car.

Studies have not yet been done on the precise effects of the proposed child-seat rule for airlines or the additional automobile travel and attendant automotive accidents, deaths, and injuries of children and their parents. However, the rule-making process may not wait for such studies to be completed.

In lieu of the requisite research, it should be noted that our own econometric research (undertaken with colleagues at the University of Mississippi and Clemson University for the Center for the Study of American Business) on the impact of airline deregulation documents a point that the FAA and Congress must keep in mind: Air and highway travel are interchangeable, and changes in airline fares significantly alter the amount of highway traffic.[6] And highway accidents, injuries, and deaths are highly correlated with the amount of travel and highway congestion.

---

[5] Accident Facts: 1988 (Chicago: National Safety Council, 1988).

Indeed, we found that airline deregulation, which led to lower air fares and an expansion of flights, increased air travel by an annual average of 11 percent and reduced passenger car travel by an annual average of just under 4 percent between 1978 and 1986.[7] Accordingly, airline deregulation significantly reduced highway accidents, injuries, and deaths.[8]

Our research suggests that there is every reason to believe that the proposed air fare increases for families by way of a safety-seat requirement should have the opposite effect. The only unsettled issue is, How much?

If the number of automobile trips by families goes up by a third of the estimated reductions in infant boardings and if the average length of the round-trips is 800 miles, the increase in automobile travel will go up by more than 185 million miles.[9] That represents a very small percentage increase in automotive travel.

---

[6] Richard B. McKenzie and William F. Shughart, Deregulation's Impact on Air Safety: Separating Fact from Fiction (St. Louis: Center for the Study of American Business, Washington University, September 1987); and Richard B. McKenzie and John T. Warner, The Impact of Airline Deregulation on Highway Safety (St. Louis: Center for the Study of American Business, Washington University, December 1987).

[7] Airline ticket prices rose significantly in 1988 and 1989. However, According to Brookings Institution researchers, air fares would have risen if airlines had not been deregulated. Air fares remain approximately 18 percent below what they would have been in the absence of deregulation [Stephen A. Winston and Clifford Winston, "The Dynamics of Airline Pricing and Competition," American Economic Review (May 1990), pp. 389-393].

[8] See McKenzie and Warner, The Impact of Airline Deregulation on Highway Safety, appendix.

[9] We think our assumptions are reasonably conservative because the average length of one-way trips of airline passengers in 1987 was 780 miles, almost equal to what we assume the additional round-trips by cars will average.

Nevertheless, using our econometric model, the increase might translate into more than 1,600 additional automotive accidents each year, and the increase in accidents could result in more than 175 additional disabling injuries and just under five additional deaths each year. The additional automobile accidents might also add up to approximately $6 million to the annual economic losses associated with automobile wrecks.[10] If the fare increase is much greater than the FAA conservatively assumes, the increased highway injuries and deaths would, of course, be greater.[11]

Many of the automotive victims will be travelers who had never contemplated air travel as an alternative. They just happened to be on the road, made marginally more congested by the infant-seat requirement, at the wrong time. Nevertheless, an unknown number of the victims would surely be infants and their parents who would have traveled quite safely on their parents' laps in airplanes.

Admittedly, our calculations are rough. The point of this commentary is that in the name of child safety, advocates of the FAA rule change should consider the prospect that while their hearts may be in the right place, their proposal may be misguided. At the very least, the FAA, Representative

---

[10] These additional costs, which are computed based on National Safety Council estimates (Accident Facts: 1988), include lost wages, medical expenses, and property damage. They do not include the costs incurred by government agencies, for example, fire departments and court systems, that will have to cope with the consequences of the additional accidents.

[11] We consider our assumptions conservative because we do not make allowance for the effect that the increased demand for seats would have on the fares of all other passengers. The FAA estimates that the number of infants that would continue to fly to remain in the neighborhood of 3.3 million, which would increase the demand for seats by almost one percent.

Lightfoot, and Senator Bond should ask that more precise statistical estimates be done before blindly adopting a mandate that sounds good -- on the surface.

The proposed rule change might reduce very slightly the number of air injuries and deaths. However, the improvement in air safety is likely to be extraordinarily small because there so few infants who are air victims, because the safety seats will not be close to 100 percent effective, and because many parents will continue to hold their infants and toddlers in their laps, especially at times when the infants and toddlers need to be fed or would otherwise disturb surrounding passengers.[12]

As a consequence, the resulting increase in automotive injuries and deaths, although quite small, could easily be several times the reduction in airline injuries and deaths. Congress and the FAA should not be in the business of creating a travel-injury problem that is bigger than the one being solved.

FN=INFANT051890 4D

---

[12] Advocates are concerned that children held on their parents laps can be thrown to the floor or ceiling in air turbulence. It would appear that such a problem could easily be solved by parents using some form of inexpensive restraining harness that are in wide use.

THE IMPACT OF AIRLINE DEREGULATION ON HIGHWAY SAFETY

by

Richard B. McKenzie
and
John T. Warner

OP 68

December 1987

CSAB
WASHINGTON UNIVERSITY CAMPUS BOX 1208 ONE BROOKINGS DRIVE ST. LOUIS, MISSOURI 63130-4899
CENTER FOR THE STUDY
OF AMERICAN BUSINESS

HIGHLIGHTS

Has airline deregulation resulted in more travel risks and deaths? To date, researchers have tried to address that question by assessing the impact of airline deregulation in 1978 on subsequent air accidents and deaths.[1]

However, by affecting how people travel, airline deregulation has very likely also affected travel on the nation's highways. Through its effects on the level and composition of ground travel, the deregulation of air travel may have reduced total travel deaths in the United States. This is likely to be the case because the fatality rate for travel by roads is marked higher than travel by air.

The primary purpose of this study is to present an estimate of the number of lives saved from reduced ground travel attributable to airline deregulation. Specifically, our research leads to two important observations relevant to the public policy debate over airline regulation:

First, after 1978 there was a marked "structural" decrease in the growth of ground travel that was unrelated to changes in a range of factors

---

Richard McKenzie is professor of economics at Clemson University and an adjunct fellow at the Center for the Study of American Business at Washington University in St. Louis. John Warner is also a professor of economics at Clemson University. The authors are indebted to Kenneth Chilton, Arthur Denzau, Hugh Macaulay, William Shughart, Murray Weidenbaum, Clinton Whitehurst, and Bruce Yandle for helpful comments on earlier drafts. They also wish to thank Melissa Ellenberg, Jody Lipford, Susan McKenzie, and Curtis Middleton, for helpful research assistance.

---

[1] See Richard B. McKenzie and William F. Shughart II, Deregulation's Impact on Air Safety: Separating Fact from Fiction, OP 65 (St. Louis: Center for the Study of American Business, Washington University, September 1987), condensed and reprinted in Regulation (November/December 1987). See also Thomas Gale Moore, "Deregulation and Safety" (Washington: Council on Economic Advisors, Executive Offices of the President, 1987); and Nancy L. Rose, "Financial Influences on Airline Safety," Working Paper No. 1890-87 (Cambridge, Mass.: Sloan School of Management, M.I.T., 1987).

that normally affect driving, including changes in the relative cost of ground travel, income, population, distribution of driving between rural and urban areas, and permissable speed of highway driving. Between 1979 and 1985, passenger-car travel appears to have been, on average each year, 3.9 percent (or about 46 billion miles) lower than the amount of driving that would have been predicted from driving patterns established in the 13 years prior to 1979. Our research convinces us that deregulation played a major role in lowering the growth in automotive travel.[2]

Second, if all of the lower passenger-car miles are directly or indirectly attributable to airline deregulation, the number of accidents avoided is very large, exceeding 660,000 a year for the 1979-1985 period. The number of lives saved is equally dramatic, perhaps ranging up to an average of almost 1,700 each year. The reduction in economic losses from automotive accidents is approximately $1.9 billion a year. Even if the decrease in car travel has only half the impact of our estimate, 300,000 fewer accidents and 800 fewer deaths are substantial figures.[3]

Our findings are instructive for one main reason. They indicate that any attempt to resurrect the type of airline regulation that was abandoned in the late 1970s may well lead to higher deaths from ground travel.[4]

---

[2] Indeed, it is difficult for us to imagine any other change in the economy that would have significantly changed driving patterns as much as airline deregulation.

[3] In seeking to assess the impact of safety improvements on automotive deaths, economists at the Brookings Institution found that, after adjusting for improvements in the "average crashworthiness" of automobiles and the decline in the average weight of automobiles during the 1947-1981 period, a 1 percent increase in miles of automotive travel increases highway deaths by approximately .431 percent. This adjusted figure is nearly equal to half of our estimated impact (our model predicts an .895 percent increase in highway deaths due a 1 percent increase in auto travel). [Robert W. Crandall, Howard K. Gruenspect, Theodore E. Keeler, and Lester B. Lave, Regulating the Automobile (Washington: Brookings Institution, 1986), p. 63].

These findings are summarized in Table 1 and discussed in the body of the study. The econometric analysis on which the conclusions are founded is presented in the appendix.

AIRLINE DEREGULATION: BACKGROUND AND CONSEQUENCES FOR GROUND TRAVEL

Policymakers are understandably concerned that the deregulation of the nation's airlines initiated by Congress in 1978 may have reduced air safety and slowed the long-run decline in air deaths. With the gradual contraction of authority at the Civil Aeronautics Board (CAB) after 1978 and its eventual demise in 1985, deregulation has meant that airlines have acquired progressively greater freedom to enter markets, restructure routes, and set fares -- in general, to compete openly with fewer government controls over how market demand for air travel will be met.[5]

The greater competition among airlines may have led to greater congestion in the nation's airways and more opportunities for accidents. Deregulation could also have led to a greater number of airlines hiring more pilots with less flying experience, and to the substitution of price

---

[4] Airline deregulation does not appear to have increased fatalities from air travel [McKenzie and Shughart, Deregulation's Impact on Air Safety]. In addition, our findings suggest that air and ground travel are sensitive to their relative prices. As a consequence, efforts to improve the safety of airlines may (unless done carefully) be counterproductive. Such efforts can raise the prices of air travel relative to ground travel and can cause travelers to return to the highways, increasing highway accidents, fatalities, injuries, and economic losses.

[5] Deregulation started in 1979 with airlines being given limited flexibility to add routes and take over unused routes. Airlines were not given the flexibility to adjust prices and routes freely until 1983.

Table 1. Average Annual Estimates of Highway Safety Improvements Attributable to Airline Deregulation, 1979-1985

Reduced automotive deaths	1,700
Reduced automotive accidents	665,000
Reduced injuries	66,000
Reduced cost	$1.9 billion

Source: Author's calculations, based on regression equations reported in the appendix.

competition for safety competition in the airline industry. Media attention given to air crashes in recent years may appear to validate such fears and to justify calls for the reregulation of the airlines.[6]

Nonetheless, the available empirical studies of the effect of deregulation on air deaths do not support claims that air safety, as measured by airline deaths and accidents, has been compromised since deregulation.[7] Still, proponents may argue that reregulation with greater attention to safety should be adopted on the grounds that it may speed the long-run decline in air accidents and deaths. Such arguments may be tendered, as they have been, with little concern for the impact of reregulation on the relative price and volume of air travel vis-a-vis other modes of travel.

The policy debate over airline reregulation has so far overlooked the important economic linkages between air travel and ground travel. Consumers can be expected to adjust marginally their travel modes among airlines, cars, and buses, depending upon the relative prices, quality of service, and availability. Reregulation can be expected to affect all three -- price, service, and availability -- just as deregulation has affected all three.[8]

---

[6] Hobart Rowen, "Bring Back Regulation," Washington Post Weekly, August 31, 1987, p. 5.

[7] See McKenzie and Shughart, Deregulation's Impact on Air Safety; Moore, "Deregulation and Safety"; and Rose, "Financial Influences on Airline Safety." Deregulation does appear to have led to more passenger-miles flown and, hence, to more reported "near misses." However, the historical connection between number of passenger-miles flown and near misses has not been changed by the advent of deregulation. The rapid growth in the reported count of near-misses between 1982 and 1986 was due to several factors, not the least of which are improvements in the reporting system and growth in the economy (and thereby miles flown). These points are developed in McKenzie and Shughart, Deregulation's Impact on Air Safety.

Concern for the effects of airline regulation on alternative modes of travel is hardly a matter of academic interest alone. If automotive deaths are related to miles traveled and if airline deregulation has caused a net substitution of air for ground travel, then airline deregulation could be responsible for a net reduction in travel accidents and deaths.[9] This is especially true since an increase in air deaths has not been observed and the death rate per vehicle-mile traveled on the nation's roads is substantially greater (perhaps as much as 100 times greater) than the death rate per passenger-mile traveled in the air.[10] Similarly, reregulation of airlines could cause a reverse substitution -- ground for air travel -- leading to more ground-travel deaths with or without a reduction in air deaths.

Airline deregulation has increased passenger-miles flown. According to one estimate, the increase in flying attributable to deregulation averaged, between 1979 and 1986, more than 11 percent a year for domestic airlines flying in the domestic market.[11] What is not known is the extent to which greater air travel has, on balance, altered ground travel. Although it may be reasonable to suspect that ground travel has declined, there exists no strong a priori, theoretical reason for believing that airline deregulation has, on balance, reduced ground travel.

---

[8] See Moore, "Deregulation and Safety."

[9] The scholarly research designed to test the impact of government regulation of automobile safety does indeed support the commonly held expectation that, after adjusting for a number of variables that affect automobile design, miles of ground travel is positively and significantly related to the number of automotive deaths. See Crandall, et al., Regulating the Automobile, chap. 4.

[10] During the first half of the 1980s, the air death rate per billion passenger-miles was approximately .3, while the highway death rate per billion vehicle-mile was approximately 37. Note the comparison is drawn between the death rates for vehicle-miles on the ground and passenger-miles in the air. Since vehicles often have more than one occupant, each vehicle-mile actually represents more than one passenger-mile of travel. Thus, the risk of death per mile per auto passenger is probably less than 100 times that of air travel. However, the necessary counts of passenger-miles on the ground are not available for strict comparisons of death rates.

Airline deregulation has probably had a mixed impact on the volume of ground travel. On the one hand, because of lower fares and more flights since deregulation, many travelers may have parked their cars in favor of planes for long- and even short-distance flights. On the other hand, deregulation sets in motion economic forces that may have marginally increased ground travel.

First, many of the additional air-miles induced by deregulation may have been flown by travelers who would not otherwise have taken as many trips. The additional air travel may have given rise to more ground travel (to and from airports, if nothing else).

Second, greater efficiency in the airline industry due to deregulation may have marginally increased national income and, therefore, may have led to a greater demand for ground travel (as well as air travel).

Third, deregulation may have reduced air service to small rural airports (where service was required by the CAB), causing many travelers who would have flown to drive farther to airports or to switch altogether from planes to cars for some trips.

The impact of airline deregulation on ground travel is made more complex by the fact that planes, in general, fly a more direct path than cars are driven. Hence, any net increase in miles flown could be accompanied by an even greater net reduction in miles driven.

---

[11] McKenzie and Shughart, Deregulation's Impact on Air Safety, pp. 16-19.

Even if airline deregulation has reduced the total number of miles driven, it does not follow, necessarily, that automotive deaths have fallen. This is the case because airline deregulation may have significantly redistributed the total number of miles driven between urban and rural streets and highways. Because death rates differ for rural and urban driving, the recomposition (if any) of miles-driven due to deregulation can affect total automotive deaths.

The central task of this study is to answer empirically two questions: First, independent of all other forces affecting travel, how has airline deregulation affected total passenger-car miles driven? Second, if ground travel has been affected by airline deregulation, what is the empirical relationship between volume of ground travel and automotive accidents, deaths, and economic losses from automotive accidents?

THE IMPACT OF AIRLINE DEREGULATION ON GROUND TRAVEL

Ground travel is, of course, influenced by many factors other than the extent of airline regulation. Several of the more important determinants of the volume of ground travel include the relative cost of ground transportation (including the price of gasoline and the cost and maintenance of cars), disposable income, population, and permissible driving speed.

Vehicle-miles traveled can be expected to be negatively related to the relative price of ground transportation. The quadrupling of gasoline prices in the 1970s, for instance, likely reduced vehicle-miles, while the reduction in gasoline prices in the 1980s probably stimulated miles driven.

Vehicle-miles could be expected to be directly related to disposable income: higher income, higher vehicle-miles. The gradual increase in the country's population over time has very likely increased the demand for travel of all kinds. The permissible speed on the roads affects the time-cost of travel. Because it increased the cost of ground travel, the decrease in the speed limit for interstate highways in the mid-1970s probably reduced the willingness of people to use their automobiles.

The problem of assessing the impact of airline deregulation on ground travel is statistical, one of separating the individual effects of these variables, including airline deregulation, from each other. This section of the study describes in general terms the estimated separate influence of deregulation on various categories of ground travel. (The econometric techniques employed to obtain these and other results are summarized and discussed in the appendix, Table A-1 through Table A-4.)

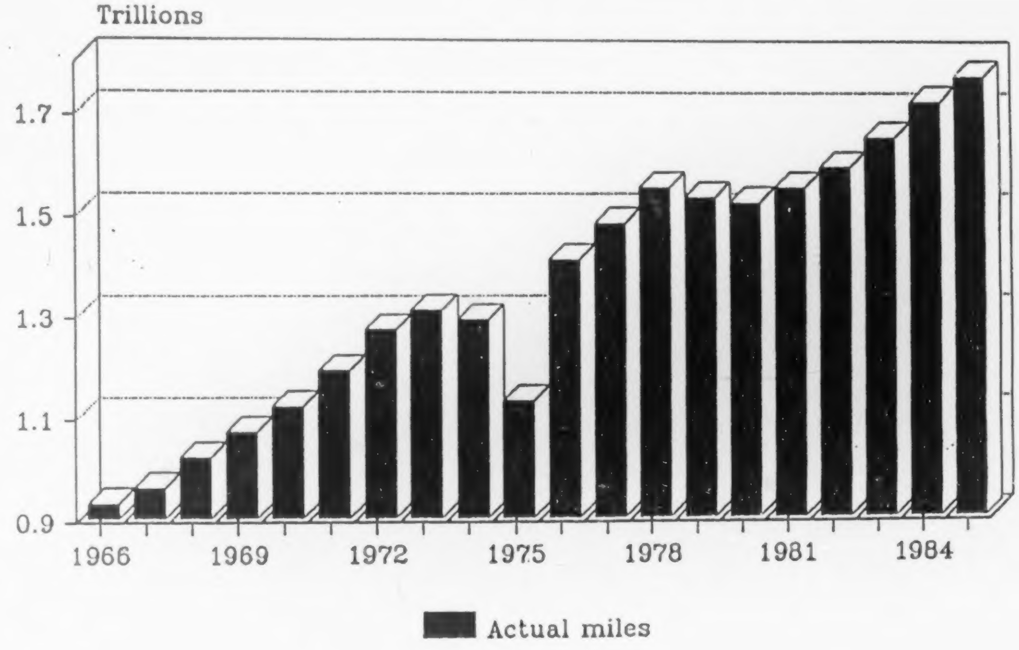
Vehicle-Miles

The history of miles driven by all types of vehicles (cars, buses, motorcycles, trucks, etc.) is portrayed by the bars in Figure 1. The trend is decidedly upward, from .9 trillion vehicle miles in 1966 to nearly 1.8 trillion vehicle miles in 1985.[12] However, as evident in the figure, growth in the total number of vehicle miles began to slow slightly in the

---

[12] Federal Highway Administration, U.S. Department of Transportation, Highway Statistics: Summary to 1985 (Washington: U.S. Government Printing Office, n.d.), pp. 227-228.

Figure 1. Total Vehicle Miles
1966–1985



Source: Federal Highway Administration

late 1970s, partially due to increases in energy prices and to reductions in the growth in real national income in the late 1970s and early 1980s.

Passenger-car miles account for approximately 70 percent of total vehicle-miles. For our purposes, it is the impact of airline deregulation on passenger-car miles that is of interest. This effect is evident in Figure 2, which plots all passenger-car miles on all roads (from rural interstate highways to urban streets). The gap between the solid bar series representing actual miles driven and the shaded line graph representing the predicted miles driven (without considering the impact of airline deregulation) gradually widens beyond 1978. (The graph intentionally accentuates this gap by truncating the vertical axis and expanding the scale for the relevant portion of the graph.) The percentage of difference in predicted and actual miles for each year is 3.9 percent, on average.[13]

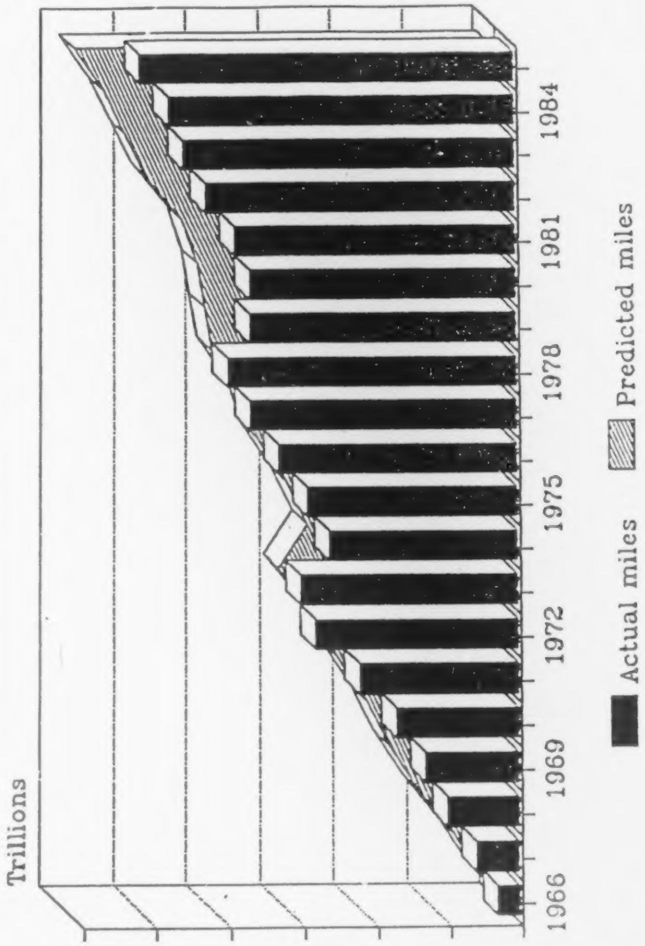
Econometric analysis indicates that the gap between the two series in Figure 2 is statistically significant (not a matter of random chance; see appendix Table A-2, equation 2). That is to say, something caused a divergence between actual and predicted miles driven by automobiles after

---

[13] Our analysis indicates that airline deregulation may have depressed total vehicle miles by an average of 4.5 percent a year between 1979 and 1985 (see Table A-1, equation 2). However, statistical tests indicate that there is a reasonable probability that the observed relationship between total vehicle-miles and the variable (called a dummy variable) used to represent airline deregulation may not reflect the true relationship.

The full negative impact of deregulation on vehicle miles may be partially obscured by the impact of trucking and intercity bus deregulation that occurred during approximately the same period as airline deregulation. The deregulation of trucks and buses could have also led to greater competition among truck companies and bus lines and to more trucks and buses driving more miles at lower prices per ton-mile of cargo. For this reason alone, our analysis must be extended and focused on the impact of airline deregulation on the type of travel most likely affected, namely travel via passenger cars.

Figure 2. Passenger Car Miles
Actual and Predicted, 1966-1985



Source: FHA and authors' calculations

1978.[14] Since the model does a good job of estimating automotive travel, that "something" has to be a factor other than the ones included in the model.[15] We believe the external factor to be the substitution of air travel for automobile travel as a result of lower air fares and increased number of flights due to airline deregulation.[16] Further, we are hard pressed to develop satisfactory alternative explanations for a different external factor that could explain the observed gap.[17]

---

[14] The dummy variable for deregulation in the econometric equation is significant at a confidence level of .01.

[15] The gap between actual and predicted passenger-car miles is statistically significant and virtually the same in a variety of the statistical models tried. When a Spline variable is used to represent airline deregulation, the coefficient is .014 (and statistically significant at a .01 confidence level). This means that airline deregulation was depressing car travel by 1.4 percent more each year. Such an estimate means that by 1985, car travel may have been 9.8 percent less that it would otherwise have been.

[16] Given inherent imprecisions in our statistical methods, we cannot "prove" that the entire gap can be explained by airline deregulation. The gap in Figure 2 amounts to an annual average of 46 billion passenger-car miles, and it is difficult for us to believe that airline deregulation, alone, could have depressed passenger-car travel by that much. Granted, available estimates indicate that domestic air travel increased by about 147 billion passenger miles between 1978 and 1985. However, the impact of airline deregulation, by itself, has been estimated to be responsible for 25 percent of this increase or 38 billion passenger miles (McKenzie and Shughart, Deregulation's Impact on Air Safety). It is possible that the estimated reduction in passenger-car miles could be greater than the estimated average increase in air-passenger miles. As noted, planes can often go between two locations in fewer recorded miles than cars. In addition, the air-passenger estimates do not include any domestic flights by foreign airlines.

[17] The growing gap between actual and predicted passenger-car miles may be explained in part by the deregulation of telephones, by changing living patterns, and the growing cost of automobile regulation. However, we question just how much of an impact these changes could have had. We tried a statistical model including a dummy variable for telephone deregulation, but the impact of the Spline variable used to represent airline deregulation did not change materially, either in terms of statistical significance or magnitude. We also tried a model that included a trend variable (which might capture changes in a number of variables, such as

When the impact of deregulation on car-miles driven on rural (interstate and main arterial) highways is assessed, the same conclusion can be drawn. "Something," very likely including airline deregulation, significantly decreased rural car-miles driven after 1978. The decrease in car-miles driven averaged 3.7 percent per year in the post-deregulation period (Table A-4, equation 2).[18] However, the decline in car-miles driven on urban highways (including interstates) and streets after 1978 was significantly greater on average, 6.4 percent (Table A-3, equation 2).

General Findings

In summary, our research on the determinants of the volume of passenger-car travel supports the view that the number of miles driven is primarily affected by the relative cost of automobile travel, income, population, and speed. In general, higher relative prices tend to suppress driving, whereas a greater population and higher average speed tend to encourage driving -- exactly as anticipated. While a change in per capita disposable income tends to have a positive impact on driving, its effect was not always certain (at least by the standards of precise statistical tests).[19]

---

living patterns, that cannot be easily measured). However, the Spline variable remained close to the upper limit achieved in all other specifications. The growing cost of automobile regulation is captured in our transportation price index.

[18] The coefficient on the Spline variable for deregulation was 1.3 percent and significant at the .01 confidence level.

[19] While we suspect the true effect of income on miles driven may be obscured by the limitations of the data, our results are not totally unexpected. Increases in income definitely affect airline travel, and some of the increase in air travel attributable to higher income may be taken off the roads. To economists, car travel (relative to air travel) may

Our analysis also shows that between 1979 and 1985, airline deregulation appears to have significantly reduced miles driven in passenger cars on America's highways and streets. The percentage of reduced passenger-car miles may be viewed as relatively "small." However, if automotive deaths are directly proportional to passenger-car miles driven, our statistical findings suggest that airline deregulation may have reduced automotive deaths by an annual average of nearly 1,900 (given that automotive deaths averaged approximately 48,600 per year for the 1979-1985 period). In order to develop a more precise estimate of the number of lives saved through airline deregulation, the relationship between deaths and passenger-car miles driven is carefully examined in the following section.

THE IMPACT OF AIRLINE DEREGULATION ON GROUND TRAVEL SAFETY

The central point of the previous section is that airline deregulation has significantly reduced miles of ground travel. The task of this section is to specify the relationship between miles of automobile travel by passenger cars and measures of numbers of accidents, costs, and deaths. With this additional information, we will be able to provide rough estimates of the effect that airline deregulation has had on ground-travel "safety." It appears reasonably clear from our analysis that miles of automobile travel are directly related to our various measures of automotive safety. What remains somewhat uncertain in the statistical

---

be an "inferior good" (which means consumption levels and income levels are inversely related) for many people. For others, air travel may be a perfectly normal good. The uncertain effect of income on net vehicle-miles may reflect the mixed reactions of various drivers.

investigation is the extent to which automotive safety is affected by any given reduction in ground travel.[20] For that reason, we report below the most conservative estimates that we found of safety improvements due to less ground travel.

Automotive Deaths

The ongoing long-run change in automotive safety is most prominently illustrated by the annual number of automotive deaths on all roads. The bars in Figure 3 shows that the actual total automotive deaths rose irregularly from slightly more than 53,000 in 1966 to over 56,000 in 1972, only to fall with equal irregularity thereafter until total deaths were down to under 46,000 in 1985.[21]

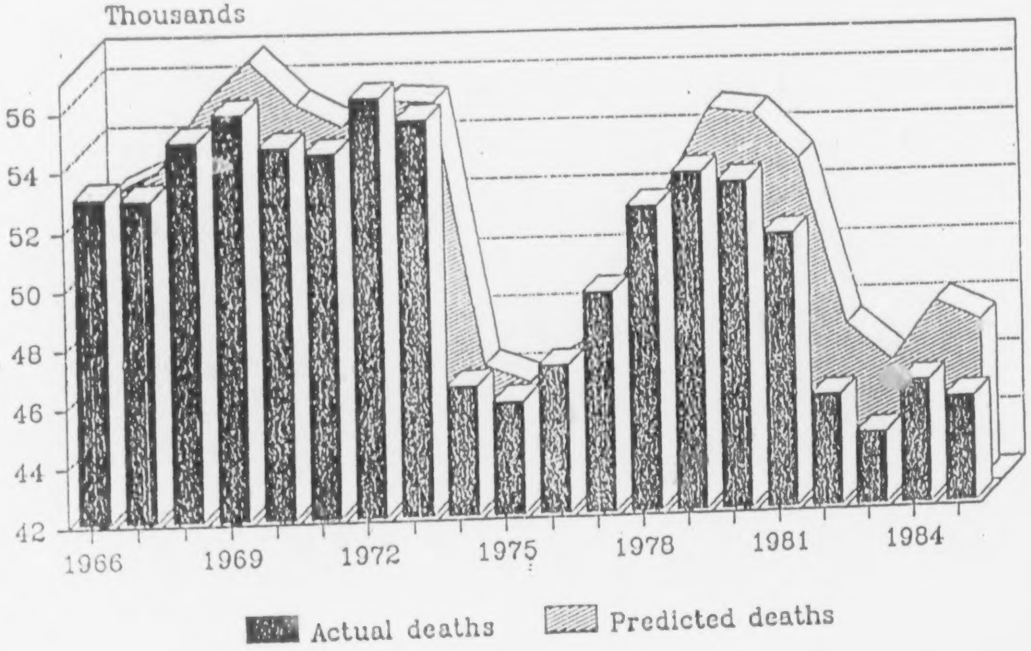
The statistical problem of estimating the importance of airline deregulation in the observed improvement in automotive deaths is made complex by the fact that many factors that influence highway safety are constantly changing. However, we found that consistently more than 60 percent of the variation in automotive deaths could be explained by four principal forces:

---

[20] The reported findings should be read with one important caveat in mind. As may be obvious from careful examination of the statistical results reported in the appendix (in the form of several regression equations), the exact computed impact of miles driven on all measures of automotive safety depends critically upon the way in which the expected explanatory variables are combined in the equations (see Tables A-5 and A-6).

[21] The change in passenger-car deaths was more dramatic than the change in total deaths over the 1966-1985 period. Passenger-car deaths rose from 35,000 in 1966 to 37,100 in 1969 and fell to 23,800 (or by 36 percent) by 1985.

Figure 3. Total Automotive Deaths
Actual and Predicted, 1966–1985



Source: FHA and authors'calculations

(1) vehicle-miles traveled (which generally rose during the period covered by Figure 3),[22]

(2) per capita consumption of alcoholic beverages (which tended to rise until 1973 and fall thereafter),[23]

(3) proportion of drivers who are females (which rose gradually from 41.1 percent in 1966 to 48 percent in 1985), and

(4) proportion of drivers who are teenagers (which rose from 8.8 percent in 1966 to 9.1 in 1974, only to fall back to 6.4 percent in 1985).

The first three factors were generally found to influence deaths to a statistically significant degree. We expected the percent of drivers who are teenagers to also be a significant determinant of deaths, but the relationship was found to be unpredictable.[24] The relative importance of these factors in explaining automotive deaths is evaluated by econometric analysis in the appendix.

The important finding is that during the 1979-1984 period, every 1 percent increase in total passenger-car miles increased total automotive deaths by just under .9 percent (again, using the most conservative estimate of the relationship between percentage change in miles and deaths, see appendix Table A-5, equation 2).[25] This means that the estimated reduction in passenger-car miles (3.9 percent for the 1979-1985 period) may have reduced total automotive deaths by an average of 3.5 percent.

---

[22] Of course, many other highway conditions affect highway safety through their influence on miles driven. To include the indirect effects of changes in transportation prices, income, population, speed, and airline deregulation on automotive safety, we used the econometric work on vehicle-miles, reported in Appendix A, to forecast miles of travel and then used the forecasted miles-driven as a determinant of highway deaths.

[23] Alcoholic consumption includes total purchases of beer, wine, and distilled spirits in real dollar terms.

[24] The variable accounting for changes in the teenage population may not have been a statistically significant influence in part because of the relatively small change in teenage drivers as a percent of all drivers.

These statistics mean that airline deregulation may have "saved" an average of 1,700 lives each year between 1979 and 1985.[26] Put differently, if the airline industry had not been deregulated in 1978, ground travel would have been significantly higher than it actually was and automotive deaths may have been, on average, 1,700 higher each year than they actually were.[27] The predicted number of deaths -- computed by assuming that passenger-car travel continued to follow in the 1980s the pattern established prior to airline deregulation -- is described by the shaded series in the background of Figure 3. Note that the shaded series (predicted deaths) is higher than the bars (actual deaths) after 1978.

We also sought to investigate the possible role of safety improvements in automobiles in reducing automotive deaths. We attempted to adjust our econometric analysis in various ways for design improvements in automobiles by including a safety index, changes in the average age of automobiles on the road, and changes in the size of automobiles (as measured by fuel economy).[28] The impact of these adjustments was, generally, to increase substantially (by as much as 50 percent) the measured impact of the number of passenger-car miles on automotive deaths.[29]

---

[25] The period of analysis is restricted to 1979-1984 because of the absence of data on alcohol consumption for 1985. Estimates of reductions in automotive deaths due to airline deregulation are based on data on automotive deaths reported by the Federal Highway Administration, Highway Statistics: Summary to 1985.

[26] The number of total automotive deaths for 1979-1985 period averaged 48,597.

[27] These findings are supported by additional analysis of the impact of airline deregulation on the deaths of people in passenger cars via a reduction in passenger-car travel (separate from other forms of travel). We estimate that between 1979 and 1985, changes in passenger-car fatalities were virtually proportional to miles driven in passenger cars. This means that airline deregulation, which led to an average 3.9 percent reduction in passenger-car miles, also led to a reduction in passenger-car fatalities by an average of 3.9 percent.

Other researchers have found that after adjusting for several additional variables, including a more complicated safety index in automobiles, a 1 percent reduction in miles traveled reduced deaths by .43 percent in the 1947-1981 period -- or by about half our estimate.[30] Using this estimate of the impact of travel on deaths, we can still deduce that the number of lives saved would be substantial, more than 800 a year.

---

[28] John Graham found that relative to 1965, the "crashworthiness" of automobiles exhibited the following improvements: 4 percent for 1966 and 1967; 19 percent for 1968 and 1969; 24 percent for 1970 and 1971; 28 percent for 1972 and 1973; and 34 percent for 1974 and all following years [John D. Graham, "Automotive Safety: An Investigation of Occupant Protection Policies" (Pittsburgh: Carnegie-Mellon University, Ph.D. dissertation, 1983), tables 3-11]. Our index for design improvements was simply 1 for 1965 and 1 minus the percentage safety improvement for the years 1966 through 1984.

[29] The statistical significance of the coefficient for passenger-car miles was reduced, compared to the unadjusted equations.

[30] Crandall, et al., Regulating the Automobile, p. 63. These Brookings researchers included in their regression equations six variables not represented in our analysis reported in the appendix: safety improvements in automobiles, average weight of automobiles, the OPEC oil embargo, average age of automobiles, percent of travel by trucks, and percent of travel on limited access roads. We did not attempt to replicate completely the work by these researchers. At the same time, our extended analysis did include regression equations that were comparable in terms of the types of variables used. We do not report these extensions in the appendix because the reported estimates of the impact of travel remain more conservative. In addition, we encountered severe problems of multicollinearity. We also worry that the Crandall study does not find a consistent, statistically significant relationship between per capita alcohol consumption and highway deaths. We suspect also that the authors' variable for the OPEC oil embargo (that has a negative sign and runs through 1981) captures some of the negative impact of airline deregulation.

Automotive Accidents

In 1985 there were approximately 19.3 million automotive accidents involving injuries and resulting in property damage to 33 million vehicles.[31] Our analysis indicates that accidents are significantly influenced by passenger-car miles driven.[32] Using our most conservative finding, we estimate that the 3.9 percent fewer passenger-car miles driven in the 1979-1985 period may have reduced automotive accidents by an annual average of approximately 3.6 percent, or by 665,000 (Table A-6, equation 1).

Assuming that the number of vehicles involved in accidents and the number of injuries suffered in accidents are roughly proportional to the number of accidents, the estimated reduction in accidents would have resulted in approximately 66,000 fewer injuries (total disabling and nondisabling injuries).[33] Many, if not most, of these accidents and injuries avoided were, without much question in our view, due to the deregulation of airlines.

---

[31] National Safety Council, Accident Facts: 1986 (Chicago: 1986), p. 40. Estimates of reductions in accidents, injuries, and economic losses are based on data collected from various annual editions of Accident Facts.

[32] Any percentage increase in passenger-car miles has a proportionally greater impact on total automotive accidents than an equal percentage increase in total vehicle-miles. We estimate that a 1 percent increase in total vehicle-miles will increase total automotive accidents by .4 percent, whereas a 1 percent increase in passenger-car miles will increase total automotive accidents by about 1 percent.

[33] The econometric analysis reveals that vehicle-miles has an uncertain positive influence on total automotive injuries, although miles and injuries were directly related consistently throughout several statistical tests. The statistical problem may be a reflection of the way injuries are estimated and how they are reported.

However, for reasons already cited, it is difficult to believe that airline deregulation is solely responsible for all of the estimated reductions in accidents. Nonetheless, if airline deregulation had only half the estimated impact on highway safety, then there still were on average over 300,000 fewer automotive accidents per year because of airline deregulation.

Economic Cost

Automotive accidents impose economic costs on motorists in a variety of ways. Medical care and automotive repairs are the most visible. The lost national production, due to injuries and deaths, are not so apparent. In 1966, according to the National Safety Council, the estimated total economic cost from automotive accidents was slightly more than $33 billion (in terms of 1985 dollars). By 1985, the total economic cost escalated by 47 percent in real-dollar terms, to $48.6 billion.[34] While cost figures for various years may not be fully comparable, we estimate from the available data that vehicle miles of travel and economic loss from automotive accidents are nearly proportional: a 1 percent increase in travel leads to a 1.01 percent increase in economic cost (see Table A-6, equation 2).[35] Therefore, the 3.9 percent average reduction in passenger-car travel may have also reduced economic loss from automotive accidents by an annual average of 3.9 percent, or by $1.9 billion a year, in the 1979-1985 period. Again, even if airline deregulation had only half of this estimated effect, then economic losses avoided would be close to $1 billion.

---

[34] National Safety Council, Accident Facts: 1986 (Chicago: 1986), p. 4. The total economic loss includes $16.1 billion in lost wages, $3.9 billion in medical expenses, $9.3 billion in insurance administration, and $19.3 billion in property damage to motor vehicles. The cost estimates do not include the expenses incurred by public agencies (for example, policy and fire departments and courts), value of cargo losses to commercial vehicles, and damages awarded in excess of direct losses.

[35] The National Safety Council warns that its estimated cost of accidents in various years may employ different estimating techniques (Ibid.). For that reason, the estimated reduction in economic losses must

General Findings on Automotive Safety

According to our analysis, the reduced rate of growth in passenger-car miles due to increased air travel since airline deregulation has significantly improved travel safety. The estimates of improved highway safety for the 1979-1985 period reported above are summarized in Table 1.

Our research suggests that automotive safety gradually improved over the 1979-1985 period as air travel was progressively substituted for ground travel. We cannot state with statistical certainty how much of the measured safety improvements are attributable to airline deregulation. At the same time, our most conservative estimates of safety improvements are substantial.

In addition, we found, as anticipated, that the number of automotive accidents, and the deaths and economic losses related to them, is significantly and directly related to per capita alcohol consumption (measured in real dollar terms) and is significantly and negatively related to the growing percentage of female drivers.[36] That is, the observed

---

be considered rough.

[36] The Brookings researchers did not find that per capita alcohol consumption, measured in gallons per year, was a statistically significant determinant of automotive deaths. Because alcohol consumption, measured in real dollar terms, and automotive deaths are strongly related in our analysis, we are inclined to believe that the "safety" and "weight"

long-run downward trend in automotive deaths is also partially attributable to the reduction in per capita alcohol consumption and to the growing percentage of women drivers. In general, ongoing changes of ground travel between rural and urban roads did not significantly influence our measures of highway safety. Finally, our analysis also reveals that automotive safety is reduced by increases in speed, population, and income and by decreases in transportation prices.

CONCLUDING COMMENTS

Estimates of the impact of airline deregulation on ground-travel safety are only approximate, even under the best of conditions. Nonetheless, the statistical analysis undertaken is useful for two reasons. First, it indicates, at the very least, the general direction of the change in automotive safety due to airline deregulation. Our findings support our expectations of a positive relationship between airline deregulation and highway safety.

Second, the analysis provides rough estimates of the actual impact. While acknowledging the imprecision in the statistical findings, we are confident that airline deregulation has significantly reduced ground travel and, in turn, the reduction in ground travel has significantly reduced automotive accidents, injuries, deaths, and economic loss.

Although we relied on the most conservative estimates, we suspect that our reported estimates of the benefits of airline deregulation on highway

---

variables included in the Brookings study pick up a part of the impact of alcohol consumption (Crandall, et al., Regulating the Automobile, pp. 63 and 64).

safety may represent the upper bounds of the true effects.[37] By the same token, it is difficult to believe that roadway safety is not significantly and directly influenced -- holding all other major influences constant -- by the amount of travel. Our findings leave substantial margin for statistical imprecision without disturbing our more general conclusion: During the 1979-1985 period, airline deregulation has each year significantly lowered automotive accidents (measured in hundreds of thousands), fatalities (measured in hundreds), and economic losses (measured in hundreds of millions of dollars).

Unless legislative precautions are taken, reregulation of the airline industry could drive some air travelers back to the nation's roads and could increase ground-travel accidents, injuries, deaths, and economic losses. Even if airline reregulation resulted in improved air safety, overall travel safety could be reduced.

---

[37] This may be so because the statistical techniques used may overstate the impact of airline deregulation. A part of the measured reduction in miles driven may actually be due to, say, greater use of telephones, and a part of the measured improvement in highway safety due to safety improvements in vehicles and roads. As we have noted, the computed percentage impact of airline deregulation on miles of ground travel and the percent impact of miles of travel on measures of safety varies significantly with the combination of variables used, a point that is made clear in tables in the appendices containing the regression equations.

APPENDIX: ECONOMETRIC ANALYSIS

INTRODUCTION

In this appendix we specify the econometric model we used to obtain the estimates reported in the text and present the detailed results of estimation of that model. Our model is a two equation recursive model that first assesses the impact of airline deregulation on ground travel and then the impact of ground travel on one of the following measures of highway safety: deaths, accidents, or costs. The guiding argument is airline deregulation must affect highway safety through its impact on highway usage and congestion.

SPECIFICATION OF THE MODEL

As explained in the text, theory suggests that ground miles traveled should depend on a limited number of variables: the relative price of ground travel as measured by the private transportation price index (PT), real disposable income per capita (DIPC), population (POP), and average highway speed (SPEED). Also, if in fact airline deregulation has, on balance, influenced the volume of ground travel, an additional variable that measures the influence of deregulation should prove significant.

Two different measures of the influence of deregulation were explored. One measure is a dummy variable (DEREG) for the deregulation period. DEREG has a value of 1 for years 1975-85 and 0 for the early period. The second measure is a Spline variable for "time since deregulation" (TSD). For each year since deregulation, TSD equals year minus 1978; for all preceding years TSD is 0. This Spline measure allows the effect of airline deregulation to grow with time. Since any effect of airline deregulation on ground travel was probably not instantaneous, this measure is expected to fit the data better than the DEREG dummy.

Ground travel, in turn, can affect deaths, accidents, and accident costs. In addition, holding the amount of ground travel constant, other variables may affect deaths, accidents, and costs. We initially assumed these additional variables would include alcohol consumption per capita (ALCOPC), the percentage of drivers who are female (PCTFEM), the percentage who are less than 20 years old (PCTLT20), and the ratio of urban to rural travel (URBRUR). ALCOPC should be positively related to deaths, accidents, and costs. Because female drivers have historically been less accident-prone than their male counterparts, we expect that PCTFEM will be inversely related to deaths, accidents, and costs, while we anticipated that PCTLT20 will be positively related. The variable URBRUR is included to control for any effect that changes in the composition of driving might have on deaths, accidents, and costs. We have no strong prior about the sign of this variable.

The initial specification of the miles traveled/deaths model is thus:
$M_t = a_0 + a_1 PT_t + a_2 DIPC_t + a_3 POP_t + a_4 SPEED + a_5 DEREG_t + u_{1t}$
$D_t = b_0 + b_1 M_t + b_2 ALCOPC_t + b_3 PCTFEM_t + b_4 PCTLT20 + b_5 URBRUR_t + u_{2t}$, where M_t is ground miles traveled at time t, D_t is automotive deaths at time t, and u^{1}_{t} and u_{2t} are random errors. In the alternative version of the model, the variable TSD replaces the variable DEREG in the first equation. Models for accidents (A) and accident costs (C) simply replace D_t with A_t and C_t, respectively, in the second equation. As formulated, the model is

recursive, and both equations may therefore be estimated by ordinary least squares.[38]

An alternative specification was also considered. Our theory suggests that SPEED influences miles traveled directly through its effect on the cost of ground travel. SPEED therefore affects highway deaths partly through its effect on miles traveled. However, holding miles traveled constant, SPEED may also affect deaths directly. If this is so, SPEED should also appear in the deaths equation. Results with SPEED in the second equation are also discussed below.

RESULTS FOR HIGHWAY TRAVEL

Our estimation of the impact of airline deregulation on miles traveled is based on data for a 20-year period, 1966-1985.[39] Tables A-1 to A-4 show the results of the miles-traveled equation for four different measures of ground travel: total vehicle miles, total car miles, urban car miles, and rural car miles. Results without an airline deregulation measure are displayed in column 1; results with the DEREG dummy and then the spline variable TSD are reported in columns 2 and 3, respectively. All continuous variables are measured in logarithms; therefore the coefficients may be interpreted as measures of elasticities. All equations were corrected for autocorrelation by the Prais-Winsten method. Durbin-Watson statistics for the transformed equations are provided in the tables. For the most part, the Durbin-Watson statistics for the transformed equations are either insignificant or are in the indeterminate range.

---

[38] The model would become simultaneous if deaths affect miles traveled as well as miles traveled affecting deaths. Deaths might in fact influence miles traveled by affecting drivers' perceived injury risks. In unreported results of a simultaneous equations estimation of the model with deaths included on the righthand-side of the miles driven equation, we found no evidence that deaths affect miles traveled. The model is thus recursive.

[39] The period of analysis was determined by the availability of consistent highway travel data obtained from Federal Highway Administration, Highway Statistics: Summary (Washington: U.S. Government Printing Office, 1987).

Table A-1 contains the results for equations with miles traveled by all vehicles as the dependent variable. Although the DEREG and TSD variables in the last two columns, respectively, have negative coefficients, the estimates are not statistically significant. Hence total vehicle miles do not appear to have been significantly affected by airline deregulation. As noted in the text this result is not totally unexpected, given that trucking was deregulated at approximately the same time as airlines. After deregulation, increased truck miles may have offset reductions in car miles. Therefore, we turn to the estimated effects of deregulation on total car miles and car miles traveled on urban and rural roads, respectively.

The results of our analysis of passenger-car miles are displayed in Tables A-2 through A-4. In all cases, the deregulation variables (DEREG and TSD) are negative and statistically significant. For instance, the coefficient for DEREG in TABLE A-2 indicates that airline deregulation reduced passenger vehicle miles by -.039, or by 3.9 percent. The coefficient on the Spline variable TSD indicates an annual reduction in miles traveled of approximately -.014, or 1.4 percent, relative to what miles would have been the case in the absence of airline deregulation. The cumulative effect by 1985 is 9.8 percent (or 7 x -.014). Estimates from the urban and rural miles traveled equations are strikingly similar.

Table A-1. Equations For Total Vehicle Miles, 1966-1985

Independent Variable	Equations 1	2	3
Intercept	-6.478	-11.753	-15.720
	(4.859)	(8.274)	(9.027)
	[.182]	[.084]	[.082]
Transportation Price	.469	.713	.383
	(.277)	(.454)	(.277)
	[.090]	[.042]	[.167]
Real Per Capita Income	1.671	1.488	1.219
	(.347)	(.496)	(.506)
	[.001]	[.001]	[.016]
Population	.135	.720	1.169
	(.636)	(.991)	(1.063)
	[.833]	[.475]	[.271]
Speed	.917	.859	1.075
	(.234)	(.328)	(.260)
	[.001]	[.001]	[.001]
DEREG		-.045	
		(.044)	
		[.277]	
TSD			-.008
			(.006)
			[.229]
Durbin-Watson	2.297	2.790	2.370
R^2	.978	.979	.979

Notes:

Standard errors in parentheses.
Significance levels in brackets.

Table A-2. Equations For Total Passenger Car Miles Traveled, 1966-1985

Independent Variable	Equations 1	2	3
Intercept	-14.323 (3.691) [.001]	-16.775 (2.984) [.001]	-21.196 (3.401) [.001]
Transportation Price	-.505 (.178) [.009]	-.311 (.143) [.029]	-.694 (.116) [.001]
Real Per Capita Income	.183 (.209) [.348]	.211 (.156) [.173]	.065 (.186) [.728]
Population	1.955 (.414) [.001]	2.146 (.319) [.001]	2.577 (.393) [.001]
Speed	.606 (.141) [.001]	.570 (.105) [.001]	.684 (.109) [.001]
DEREG		-.039 (.011) [.001]	
TSD			-.014 (.003) [.001]
Durbin-Watson	1.742	1.703	1.918
R^2	.990	.994	.997

Notes:

Standard Errors in Parentheses.
Significance levels in brackets.

Table A-3. Equations For Urban Passenger Car Miles Traveled, 1966-1985

Independent Variable	Equations 1	2	3
Intercept	-25.795 (4.985) [.001]	-23.832 (3.936) [.001]	-34.041 (4.825) [.001]
Transportation Price	-.649 (.253) [.010]	-.368 (.222) [.097]	-.813 (.165) [.001]
Real Per Capita Income	.332 (.297) [.264]	.833 (.241) [.005]	.208 (.264) [.430]
Population	2.741 (.573) [.001]	2.244 (.473) [.001]	3.480 (.557) [.001]
Speed	.578 (.200) [.004]	.373 (.163) [.022]	.657 (.155) [.001]
DEREG		-.064 (.020) [.002]	
TSD			-.017 (.004) [.001]
Durbin-Watson	1.956	2.075	1.934
R^2	.992	.996	.997

Notes:

Standard Errors in Parentheses.
Significance levels in brackets.

Table A-4. Equations For Rural Passenger Car Miles Traveled, 1966-1985

Independent Variable	Equations 1	2	3
Intercept	-1.033 (3.793) [.785]	-1.488 (3.455) [.666]	-8.438 (3.952) [.032]
Transportation Price	-.373 (.201) [.063]	-.182 (.186) [.329]	-.625 (.165) [.001]
Real Per Capita Income	.108 (.237) [.649]	.117 (.202) [.549]	-.199 (.218) [.359]
Population	.697 (.447) [.119]	.906 (.393) [.021]	1.641 (.458) [.001]
Speed	.591 (.160) [.001]	.566 (.137) [.001]	.758 (.126) [.001]
DEREG		-.037 (.015) [.013]	
TSD			-.013 (.003) [.001]
Durbin-Watson	1.903	1.591	1.921
R^2	.945	.950	.975

Notes:

Standard Errors in Parentheses.
Significance levels in brackets.

In passing, note that the transportation price variable PT is negative and statistically significant in almost all of the car miles equations. However, it is positive but not significant in the total vehicle miles equation. Per capita income is estimated to have a significant positive effect on total miles but not on private passenger miles. Population and speed are estimated to have significant positive effects in all of the equations for passenger-car miles. Speed is also significant in the equation for total vehicle miles, although population is not significant.

Our finding of a negative relationship between airline deregulation and passenger-car travel could mirror, in part, a shift in driving patterns that emerged with the OPEC oil embargo in 1974 and is not reflected in the transportation price index.[40] In equations not reported, we included dummy variables for both the OPEC embargo (1966-1973=0; 1974-1984=1) and airline deregulation. However, the changes left our basic findings undisturbed. The coefficient for the deregulation dummy retained its statistical significance (at less than the .05 confidence level) and was approximately the same as before (.0383). At the same time, the oil embargo dummy was positive (contrary to expectations) but statistically insignificant (at a confidence level of .861). We then replaced the deregulation dummy with the embargo dummy. The embargo dummy was again positive and statistically insignificant.

---

[40] Crandall, et al., found a statistically significant impact for the OPEC embargo for the years 1974-1981. However, we suspect that their embargo dummy may have been picking up some of the impact of airline deregulation.

RESULTS FOR HIGHWAY SAFETY

Our estimations of the impact of automotive travel on highway safety are based on data from the 1966-1984.[41] Tables A-5 through A-7 show the equations for deaths, accidents, and costs. Tables A-4 and A-5 show results of estimation of the effects of car miles on total highway deaths and car deaths.[42] The estimated coefficients range from .895 to 1.180 and are significant at the .08 level or better. It is clear from these results that car miles traveled directly affect automotive deaths. Furthermore, the relationship is approximately proportional, meaning that a 1 percent increase in travel leads to roughly a 1 percent increase in automotive deaths (give or take .1 or .2 percent).

Notice that inclusion of the variable URBRUR in the equations has the effect of increasing the estimated impact of car travel on deaths. However, this variable is not significant at conventional levels. Therefore, we use the more conservative estimates of the impact of miles traveled on deaths in our policy analysis.[43]

---

[41] The analysis could not be extended to 1985 (which is the last year of analysis for the earlier estimations of ground travel) because data on alcohol consumption in real dollar terms was unavailable for 1985.

[42] Further analysis of the impact of total vehicle miles on highway safety was not undertaken because airline deregulation was found to be an insignificant determinant of total vehicle miles.

[43] We also estimated the effect of total vehicle miles on total deaths. The results, which are not displayed, indicated that total vehicle miles have an insignificant positive impact on total deaths. The finding that deaths depend on car miles but not total vehicle miles are not implausible because the variation in car miles in the early 1980s may have been offset by offsetting variations in, for example, truck and bus miles driven and because the death rate per mile driven is generally lower for trucks and buses than cars.

Table A-5. Equations for Highway Deaths, 1966-1984

	Equations			
Independent Variable	Total Deaths		Car Deaths	
	1	2	3	4
Intercept	5.159 (9.621) [.592]	4.401 (9.813) [.646]	1.245 (12.207) [.919]	.802 (12.602) [.949]
Car Miles	.895 (.443) [.043]	1.013 (.467) [.030]	.992 (.561) [.077]	1.180 (.593) [.046]
Alcohol Consumption Per Capita	1.127 (.471) [.017]	1.121 (.477) [.019]	1.051 (.593) [.076]	1.087 (.601) [.071]
Percent Female	-3.753	-2.948	-5.583	-4.099
		(1.290)	(1.491)	(1.576)
(1.791)				
	[.004]	[.048]	[.001]	[.022]
Percent Less Than Age 20	-.309 (.280) [.269]	-.370 [.281] (.187]	-.257 (.325) [.428]	-.399 (.311) [.199]
Urban/Rural Miles		-.449 (.436) [.302]		-.841 (.541) [.120]
Durbin-Watson	1.339	1.402	1.767	1.875
R^2	.709	.774	.907	.909

Notes:

Standard errors in parentheses.
Significance levels in brackets.

In passing, note that alcohol consumption per capita is significantly and positively related to deaths, while the percent of drivers who are female is significantly negatively related. Contrary to expectations, the percent of drivers less than 20 years of age is estimated to have a negative effect on deaths. However, this variable is not significant in any of the equations in Table A-5.

Because there may exist significant trend-related variables omitted from the equations in Table A-5, there is the possibility that the results in Table A-5 are biased. We therefore reestimated the deaths equations in first-difference form with intercepts included. The intercept coefficients will capture the effects of omitted trend-related variables. The results, which are shown in Table A-6, remain substantially unchanged from those presented in Table A-5 and provide further support for the finding that there is an approximately proportional relationship between car miles and highway deaths.

We turn now to the effects of car miles on accidents and accident costs in Table A-7. Increased car miles in equations 1 and 2 of Table A-7 clearly lead to increased accidents. The estimated effect of car miles is significant at the .01 level in both equations. Again, the effect is approximately proportional (although, as before, the estimate rises when URBRUR is included in the equation). The accident equation in column 2 is the only one in which the URBRUR variable is found to have a statistically significant effect. In that equation our estimate is that a rise in urban driving relative to rural driving serves to reduce accidents. Unlike the deaths, ALCOPC and PCTFEM have the expected signs, but do not appear to be significantly related to accidents. The estimated effect of alcohol

Table A-6. Equations for Highway Deaths, First-Differences, 1966-1984

Independent Variable	Equations Total Deaths 1	 2	 Car Deaths 3	 4
Intercept	-.001	.003	-.026	-.023
	(.026)	(.026)	(.030)	(.031)
	[.968]	[.902]	[.381]	[.461]
Car Miles	.968	1.042	1.093	1.167
	(.432)	(.444)	(.542)	(.574)
	[.025]	[.019]	[.044]	[.041]
Alcohol Consumption Per Capita	.653	.899	.670	.849
	(.369)	(.429)	(.513)	(.573)
	[.077]	[.036]	[.173]	[.139]
Percent Female	-4.553	-4.559	-3.793	-4.014
	(2.069)	(2.068)	(2.599)	(2.687)
	[.028]	[.028]	[.145]	[.135]
Percent Less Than Age 20	-.435	-.373	-.671	-.633
	(.348)	(.351)	(.444)	(.459)
	[.211]	[.288]	[.131]	[.167]
Urban/Rural Miles		-.065		-.045
		(.062)		(.076)
		[.292]		[.544]
Durbin-Watson	1.943	2.023	1.989	2.024
R^2	.624	.659	.597	.600

Notes:

Standard errors in parentheses.
Significance levels in brackets.

consumption on accidents may be partially muted by numerous small accidents that do not involve drinking. Again, PCTLT20 is insignificant in the equations in Table A-7.

We found (equations 3 and 4 in Table A-7) that car miles are also significantly and directly related to accident costs. In equation 3 of Table A-7, which excludes URBRUR, the effect is again significant and approximately proportional. In the costs equations, ALCOPC once again has a highly positive, significant effect. Although the PCTFEM and PCTLT20 have the expected signs, they are not significant. Neither is the variable URBRUR in equation 4. In addition, the inclusion of URBRUR appears to seriously distort (upward) the estimated effect of car miles on costs. In our view the small estimate, 1.010, obtained without including URBRUR, is more tenable, especially since URBRUR is not significant in equation 4.

Finally, we noted earlier that SPEED might also belong in the equations with deaths, accidents, and costs as dependent variables, as well as the miles traveled equations. The conjectured direct relationship of highway speed to highway safety was a matter of casual observation, rather than economic theory. When a SPEED variable was included it was never statistically significant; however, its inclusion substantially reduced the magnitude and statistical significance of the car miles variable and, in some cases, reversed the sign. We suspect that the effect of SPEED is approximated in part by the other variables in the same equation, giving rise to a problem of multicollinearity.[44] In addition, SPEED may also rise

---

[44] For instance, when we regressed the natural log of SPEED on ALCOPC, PCTFEM, and PCTLT20, SPEED was found to be significantly related to all three independent variables at the .03 level or higher. Therefore, SPEED is a significant determinant of the other variables in the deaths equation as well as in the travel equation. These findings suggest that ALCOPC,

Table A-7. Equations for Accidents and Costs, 1966-1984

Independent Variable	Equations			
	Accidents		Costs	
	1	2	3	4
Intercept	-9.837	-13.941	3.847	-12.221
	(5.671)	5.653	(7.285)	(10.987)
	[.083]	[.022]	[.597]	[.266]
Car Miles	.921	1.158	1.010	1.883
	(.261)	(.264)	(.244)	(.522)
	[.001]	[.001]	[.001]	[.001]
Alcohol Consumption Per Capita	.079	.006	1.503	1.336
	(.276)	(.268)	(.525)	(.534)
	[.773]	[.983]	[.004]	[.012]
Percent Female	-.657	-.011	-.495	-2.666
	(.732)	(.782)	(.786)	(1.665)
	[.369]	[.987]	[.520]	[.109]
Percent Less Than Age 20	-.046	-.168	.281	-.056
	(.151)	(.134)	(.313)	(.312)
	[.760]	[.209]	[.369]	[.857]
Urban/Rural Miles		-.553		.078
		(.236)		(.487)
		[.020]		[.872]
Durbin-Watson	1.664	1.982	1.977	1.894
R^2	.955	.971	.936	.929

Notes:

Standard errors in parentheses.
Significance levels in brackets.

and fall with a host of other highway safety conditions that could not be included in the analysis.[45]

Finally, our variable for passenger car miles may be reflecting ongoing safety improvements in automobiles resulting from forces and government mandates during the 1970s and 1980s. As noted in the text, Graham found substantial safety improvements in automobiles.[46] However, when Graham's safety index was included in our basic equation for highway deaths (Table A-5, equation 1), our basic findings remained unchanged. The coefficient for passenger-car miles remained positive and statistically insignificant (at the .671 level). When the safety index was included, along with variables for the average age of automobiles, the size of automobiles (as measured by their average fuel economy), and the percentage of miles driven by trucks, severe multicollinearity problems arose. The coefficient for passenger-car miles was insignificant (at the .187 level), but it was still positive and higher (1.08) than our reported estimate in Table A-5, equation 1.[47]

---

[45] For example, we suspect that highway speed may rise with an increase in the width and number of lanes on highways. Given the width and number of lanes, an increase in highway speed might lead to more accidents and deaths. However, we were unable to develop a satisfactory means of controlling for the multiplicity of factors like the width and number of lanes.

[46] Graham found that relative to 1965, the "crashworthiness" of automobiles exhibited the following improvements: 4 percent for 1966 and 1967; 19 percent for 1968 and 1969; 24 percent for 1970 and 1971; 28 percent for 1972 and 1973; and 34 percent for 1974 and all following years [Graham, "Automotive Safety: An Investigation of Occupant Protection Policies," table 3-11, as reported in Crandall, et al., Regulating the Automobile, p. 62].

CONCLUDING COMMENTS

Our empirical work has been necessarily limited by the availability of satisfactory measures of many factors that might influence highway safety. Furthermore, the impact of the airline deregulation variables on passenger-car miles driven and the impact of passenger car miles driven on highway safety varies with the specifications of the econometric models. At the same time, the variety of ways we sought to determine the indirect impact of airline deregulation on highway safety leads us to conclude that the expected impact is evident, and the impact is strong, both in terms of magnitude and statistical significance.

---

[47] When a trend variable (that might better represent the impact of safety improvements in both cars and roads) was introduced, the coefficient on car miles was close to 1 and positive but insignificant (at the .143 level).

RESEARCH PUBLICATION

GMR-6722

IS IT SAFER TO FLY OR DRIVE? -- A PROBLEM IN RISK COMMUNICATION

Leonard Evans
Michael C. Frick
Richard C. Schwing

Operating Sciences Department

June 19, 1989

GM

General Motors
Research Laboratories
Warren, Michigan 48090

MAY BE DISTRIBUTED OUTSIDE GENERAL MOTORS...... Not to be Reproduced Without Permission

GMR-6722

IS IT SAFER TO FLY OR DRIVE? -- A PROBLEM IN RISK COMMUNICATION

by

Leonard Evans, Michael C. Frick and Richard C. Schwing
Operating Sciences Department
General Motors Research Laboratories
Warren, Michigan 48090

June 19, 1989

To be published -- for reference update please call 313-986-2280

IS IT SAFER TO FLY OR DRIVE?-- A PROBLEM IN RISK COMMUNICATION

Leonard Evans, Michael C. Frick and Richard C. Schwing
Operating Sciences Department
General Motors Research Laboratories
Warren, Michigan 48090

ABSTRACT

In attempts to sooth the nascent fear of the scheduled airline traveller, passengers awaiting take-off are sometimes told that they have already completed the most dangerous part of their trip -- the drive to the airport. The conventional wisdom among risk communicators that air travel is so much safer than car travel arises from the most widely quoted death rates per billion miles for each -- 0.6 for air compared to 24 for road. There are three reasons why such a comparison is inappropriate. First, the airline rate is passenger fatalities per passenger mile, whereas the road rate is all fatalities (any occupants, pedestrians, etc) per vehicle mile. Second, road travel that competes with air travel is on the rural Interstate system, not on average roads. Third, driver and vehicle characteristics, and driver behavior, lead to car-driver risks that vary over a wide range. In this study, influences due to driver age, alcohol use, safety belt use, car mass, and roadway type were estimated using Fatal Accident Reporting System and other data. Expressions derived to compare risks for drivers with given characteristics to those on airline trips of given distance showed that 18-year-old, unbelted, intoxicated, male drivers of cars 700 pounds lighter than average are substantially more likely to be killed on the trip to the airport than on the flight. However, drivers with the age distribution of airline passengers are less likely to be killed on the trip to the airport than on the flight. It was further concluded that 40-year-old, belted, alcohol-free drivers of cars 700 pounds heavier than average are slightly less likely to be killed in 600 miles of rural Interstate driving than in regularly scheduled airline trips of the same length. For 300 mile trips, the driving risk is about half that for flying.

INTRODUCTION

Airline and automobile travel, which account for 98.2% of inter city traveller miles in the U.S., takes place on transportation systems that are the safest in the world. Over 18,000 airline take-offs and landings and 370 million car trips are completed daily in a safe manner.

Yet, almost daily, media attention highlights the hazards of air travel by reports of near mid-air collisions, ageing fleets, and component failures, etc. Risk communication experts attempt to counter the alarming reports and sooth the nascent fear of the scheduled airline traveller by citing risk comparisons, most often a comparison between the fatality risk of driving and the fatality risk of flying.

Airline passengers awaiting take-off are sometimes told that they have already completed the most dangerous part of their trip -- the drive to the airport. Experts frequently remind us that highway fatality rates (24 deaths per billion miles) are much higher than regularly-scheduled airline fatality rates (0.6 deaths per billion miles). Not only do safety conscious individuals reflect on these simple averages in making their fly/drive decisions, but policy analysts use them uncritically to calculate the fatality reductions derived from shifting travel from the highway sector to the air sector [1],[2].

The simple rates given above do not provide appropriate information because:

- the rates quoted are passenger deaths per passenger mile for airlines, but all traffic fatalities (all vehicle occupants, pedestrians, etc.) per vehicle mile for road travel; traveller deaths per traveller mile for each mode would be an appropriate comparison.

- road travel that competes with air travel is on the rural Interstate system, not on average roads, and
- driver and vehicle characteristics, and driver behavior, lead to car-driver risks that vary over a wide range

Whereas the fatality risk on an airline is essentially the same for all travellers regardless of personal characteristics, habits, and preferences, car crash frequency and survivability depend on a host of factors influenced by the circumstances and discretion of the driver. To emphasize the pitfalls of using averages when wide disparities exist between specific circumstances we note that the number of 20-year-old driver deaths per capita is about four times the number of 40-year-old driver deaths per capita [3] and occupant risks vary from a low of 0.32 times the average around Sunday noon to a high of 43 times the average at 3:00 a.m., that is, by a factor of 134 [4].

It is the purpose of the present paper to communicate under what conditions fatality risk in air travel is really lower than realistically equivalent car travel in the United States. While we recognize that the ratio of injuries to fatalities is much higher for highways than for airlines, our comparison in this research will be limited to fatalities. Traveller fatality risks per traveller mile for car travel are estimated for one car occupant -- the driver; fatality risks for car passengers are largely determined by driver characteristics, although lower fatality risk in rear seats[5] would cause passenger risk to be, on average, lower than driver risk. We examine the effects of driver age, alcohol use, safety belt use, car mass, and roadway system to compare fatality risks faced by car drivers to those faced by airline passengers on trips of the same distance.

METHOD AND MATERIALS

In order to estimate fatality rates for regularly scheduled airlines, we use the data on page 87 of Ref. [6], which gives such rates in the United States for the 10 years 1978 - 1987. These annual rates vary widely from year to year, from a low of 0.01 deaths per billion passenger miles in 1986 to a high of 1.70 in 1979; the rate for 1987 was 0.7. We express all rates relative to one billion traveller miles of travel, a more convenient choice (linguistically and technically) than the more common per hundred million miles of travel. The fatality rate we use to characterize airline travel in the United states is the average over the ten-year period, which is 0.551 fatalities per billion passenger miles.

The car-driver fatality rate, F, is expressed as

$$F = F_o \times M_{age} \times M_{alcohol} \times M_{belt} \times M_{mass} \times M_{road}, \quad (1)$$

where F_o is the average fatality rate for all drivers. Each of the five multiplicative factors represent departures upwards or downwards from this average, depending on whether the factor leads to higher than average or lower than average rates. For example, we expect M_{age} to be less than one for 40-year-old drivers and more than one for 18-year-old drivers; averaged over all drivers it has the value one. Eqn 1 implicitly assumes that each of the factor operates independently. Although this is not strictly correct, we view it as an adequate approximation for the present purposes.

The data source we use most in deriving the above factors is the Fatal Accident Reporting System (FARS), a computerized data file maintained by the National Highway Traffic Safety Administration containing detailed information on all traffic crashes occurring in the United States since January 1, 1975 in which anyone was killed [7]. We also use data from various other sources, which will be described as they are introduced.

TRAVELLER FATALITY RATES

The 1987 FARS data show 46,386 traffic fatalities; these occurred in 1924.3 billion vehicle miles of travel [8], for a rate of 24.1 fatalities per billion vehicle miles. Car drivers comprised 37.0% of all 1987 fatalities (18.3% were car passengers, 14.5% were pedestrians and 8.8% were motorcyclists). Data on page 54 of [9] indicate that 71% of all vehicle miles travelled are travelled by cars, leading to the following expression for the average car-driver fatality rate

$$F_o = \frac{46{,}386 \times 0.37}{1924.3 \times 0.71} = 12.56 \text{ car-driver fatalities per billion miles.} \quad (2)$$

This value is considerably higher than the value of 9.2 car occupant deaths per billion occupant miles given on page 87 of [6]. One expects a small difference in this direction because rear-seat passengers have lower fatality risks than drivers [5].

No published data on the age distribution of air travellers or air-crash victims was found. The airline passenger data were therefore obtained from the 1975 through 1985 mortality files [10] maintained by the U.S Department of Health and Human Services. We selected those fatalities coded in the International Classification of Diseases (ICD) as 841.3 (occupants of aircraft excluding crew). Airline crashes were ranked by the number of passenger deaths per crash; the largest loss of life in a single crash was 262, the eighth largest was 62, and the ninth largest was 27. We accordingly based our analysis on the eight crashes of regularly-scheduled airlines with the largest loss of life, which gave a total of 835 fatalities, 809 with known age. The distribution of these is shown in Fig. 1; however, in order to make comparisons with licensed drivers, the distribution is normalized with respect to the 759 of these airline fatalities 16 years or older.

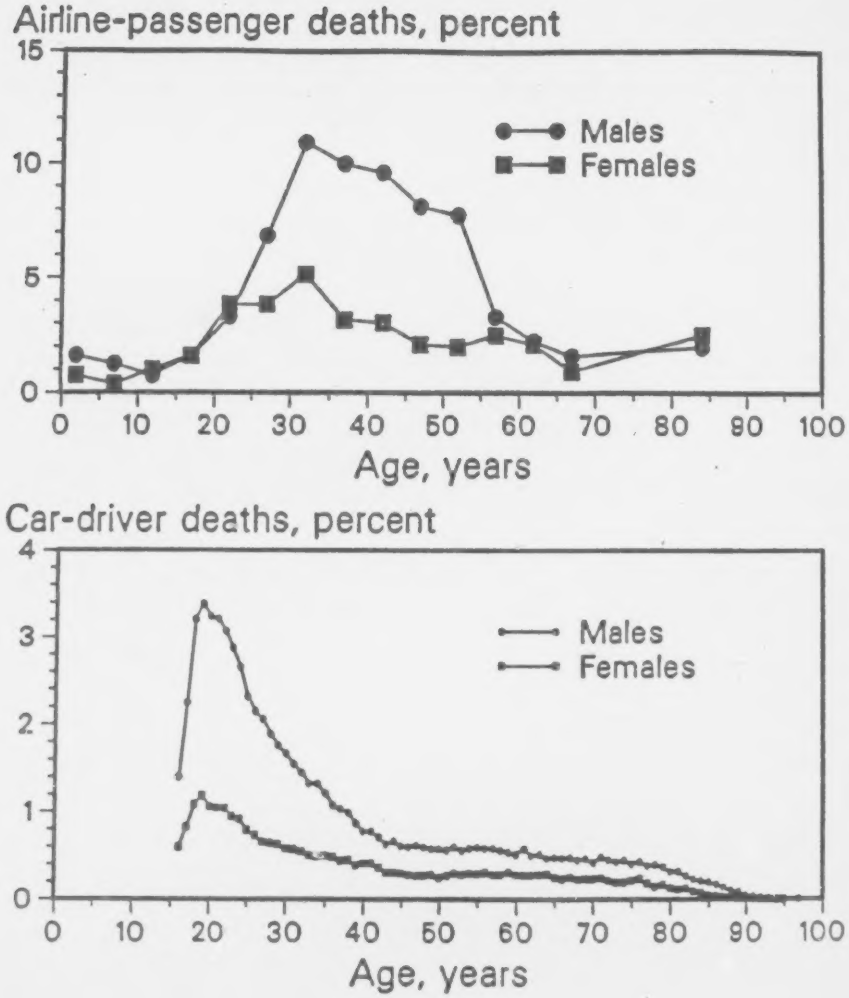


Fig. 1. Distribution by sex and age of deaths for passengers killed in air crashes (in 5-year increments) and drivers killed in car crashes (in 1-year increments). The airline data are for 809 persons killed in the 8 worst air crashes from 1975 through 1985 (the normalizing is with respect to the 759 of these aged 16 or older). The car data are for 79,220 fatally injured car drivers in the Fatal Accident Reporting System data for 1981 through 1985.

Because survival is so unlikely in a major crash of a large airline [11], the age distributions of fatalities on scheduled airlines (assuming that the sample of 8 crashes and 759 fatalities is adequate) represents, to a good approximation, the distribution of air travellers by sex and age.

In contrast to the airline case, the distribution of driver fatalities by sex and age is quite different from the distribution of car drivers. The reason for this is that car-driver fatality risk depends strongly on driver age, as shown in Figure 2. This figure shows driver fatality risk per mile relative to the average driver fatality risk per mile for all drivers, based on the same FARS and Nationwide Personal Transportation Study [12] used in [13]. From these data one can calculate the average driver fatality risk on the same trip if completed by two different populations of drivers. First, a population of drivers with the same sex and age distribution as airline passengers, and second, a population of drivers with the same sex and age distribution as the population of licensed drivers [8]. The result is that car drivers with the sex and age distribution of airline passengers have a driver fatality rate 24.1% lower than drivers with the sex and age distribution of licensed drivers. Thus, based only on differences in the distributions by sex and age, the typical airline passenger would have a driver fatality rate about 24% lower than that of the average driver.

Combining the driver fatality data for both sexes from age 34 to 45 years gives that a 40-year-old has a driver fatality risk that is 54.8% that of the average over all ages. In contrast, an 18-year old male driver has a risk that is 5.10 times the average. We can represent these age multiplier results symbolically as

$$M_{age}(\text{average airline traveller}) = 0.759 , \tag{3}$$

$$M_{age}(\text{40-year-old driver}) = 0.548 , \tag{4}$$

and

$$M_{age}(\text{18-year-old male driver}) = 5.10 \tag{5}$$

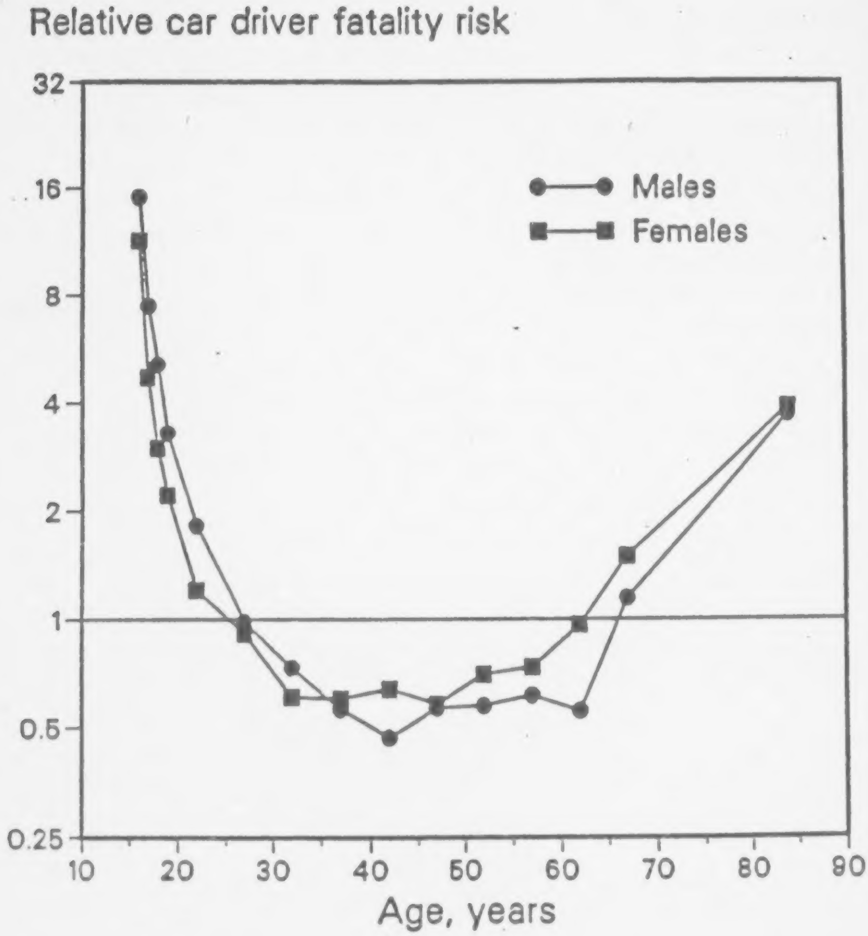


Fig. 2. Car driver fatalities per unit distance of travel relative to the average for all drivers, as indicated by the horizontal line at unity.

INFLUENCE OF ALCOHOL

The average driver fatality rate is influenced greatly by driver alcohol use. In order to derive rates for alcohol-free drivers, we used 1987 FARS data data from the same 26 states chosen in [14] because of their high rates of measuring the blood alcohol concentration (BAC, measured as the percent, by weight, of alcohol in the blood) of fatally injured drivers. These data show that, among fatally-injured car drivers whose BAC levels were measured, 52.9% had BAC = 0, and 38.0% had BAC > 0.10%, the level defining legal intoxication. In order to estimate relative risk factors, we require estimates of the fraction of drivers driving at these levels. The best such data are probably still from the landmark early 1960's study by Borkenstein et al.[15], which found that in a control sample of 7590 drivers, 89.0% had BAC = 0, and 0.764% had BAC > 0.10%. From these data we compute the following factors:

$$M_{\text{alcohol}}\ (\text{BAC} = 0) = \frac{0.529}{0.890} = 0.594\ , \tag{6}$$

$$M_{\text{alcohol}}\ (\text{BAC} > 0) = \frac{0.471}{0.110} = 4.28\ , \tag{7}$$

and

$$M_{\text{alcohol}}\ (\text{BAC} \geq 0.10\%) = \frac{0.380}{0.0764} = 4.97\ . \tag{8}$$

The estimate in eqn 6 is almost certainly high, and that in eqns 7 and 8 low, for the following two reasons. First, the control sample data [15] were not a random sample of drivers, but rather drivers sampled at times associated with crashes, which are likewise associated with increased alcohol use. Second, a noticeable decline in the incidence of alcohol has been observed throughout the 1980's [7,16]. Hence, we would expect denominators applicable to 1987 drivers to be higher in eqn 6 and lower in eqns 7 and 8. The small difference between eqs 7 and 8 reflects that only a small fraction, 9.1%, of fatally-injured drivers had BAC greater than zero but less than 0.1% -- the difference does not indicate how crash risk increases with increasing BAC.

SAFETY BELT USE

The observed driver fatality rate reflects an average over contributions from safety belt wearers and non-wearers. Using eqns 13 and 14 of [17], we estimate the fatality rate of the belted and unbelted group of drivers relative to the average for all drivers, with the following results:

$$M_{belt}(\text{belted}) = 0.492 \,, \tag{9}$$

and

$$M_{belt}(\text{unbelted}) = 1.399 \,. \tag{10}$$

These results depend on assuming that 44% of all drivers use safety belts [18], which are 43% effective [19] in reducing fatalities. The equations on which the result is based take into account well documented [20,21] differences in crash rates between belt wearers and non-wearers. If such differences are ignored, so that the only difference between wearers and non-wearers is the physical protection provided by the belts, then the eqn 9 and 10 values become 0.703 and 1.233.

CAR SIZE

Given a car crash, the probability that the driver is killed depends on the size of the car. As inter-city travel is more likely to involve single-car than multiple vehicle crashes, we estimate single-car crash risks in cars 700 pounds lighter, and 700 pounds heavier, than the the mass of the average late model car on the road (a Chevrolet Caprice is about 750 pounds heavier than average;; a Chevrolet Nova is about 550 pounds lighter than average, and an Isuzu Spectrum about 800 pounds lighter than average). Applying the relationship between single-car crash driver fatality risk and car mass given in equation 5 of [22] gives

$$M_{mass}(\text{700 pounds heavier than average}) = 0.737 \,, \tag{11}$$

and

$$M_{mass}(\text{700 pounds lighter than average}) = 1.356 \,.$$

ROADWAY TYPE

From the FARS data we find that in 1987 there were 800 car drivers killed on the rural Interstate system, compared to 16,912 killed on all types of roads (cases for which the roadway type was unknown are excluded). The corresponding distances of travel by all vehicles were 171.9 billion miles and 1,924.3 billion miles, respectively [8]. Assuming that the distance travelled by cars is proportional to the distance travelled by all vehicles gives

$$M_{road}(\text{rural Interstate}) = \frac{800}{171.9} \times \frac{1924.3}{16{,}912} = 0.530 \; . \qquad (13)$$

COMBINING THE EFFECTS

By substituting selected factors from eqns 2-13 into eqn 1, the fatality risk for various sets of drivers can be estimated. For example, the risk for a 40-year-old, alcohol-free, belted driver travelling on rural Interstate roads in a car 700 pounds heavier than average is given by

$$12.56 \times 0.548 \times 0.594 \times 0.492 \times 0.737 \times 0.530$$

$$= 0.786 \text{ driver fatalities per billion miles driven.} \qquad (14)$$

The driving fatality risk for this "low risk" driver is therefore 43% higher than the 0.55 fatalities per billion miles of airline travel.

The fatality risk for a "high risk" driver, represented by an 18-year-old, intoxicated, unbelted male driver travelling average roads in a car that is 700 pounds lighter than average, is given by

$$12.56 \times 5.10 \times 4.97 \times 1.399 \times 1.356 \times 1.000$$

$$= 603.9 \text{ driver fatalities per billion miles driven.} \qquad (15)$$

The driving fatality risk for this "high risk" driver is more than a thousand times higher than the 0.55 fatalities per billion miles average for airline travel, or 768 times higher than that of the "low risk" driver. Driving 10,000 miles annually at so elevated a risk level (for example, always intoxicated) generates a fatality probability of 0.60% per year; this corresponds to fatalities occurring at a rate of one per 166 years of driving.

The 0.55 fatalities per billion passenger miles airline rate would be independent of travel distance only if crashes were equally likely at all points on the trip. This is distinctly not so. For example, [11] states that over 90% of lethal accidents occur in the take/off climb or descent/landing phases. Even mid-air collisions tend to occur, for obvious reasons, in the vicinity of airports. All major airline crashes which have occurred over the territory of the United States in the last few decades fit this pattern, including the eight crashes in the sample which produced Fig. 1. Outside the United States a number of mid-flight crashes have occurred in the last few decades due to sabotage, structural failure, or impacting mountains. The average airline risk in domestic U.S. travel is substantially lower than the average of all other airline travel [5,11].

The concentration of hazard at the beginning and end of flights leads us to make the assumption that when a passenger boards a regularly scheduled U.S. domestic flight, fatality risk is independent of the scheduled distance of travel. This involves the additional assumption that the number of take-offs and landings is independent of trip distance. Average passenger trip distances have been stable during the 1980s at close to 880 miles [23], so we conclude that the average fatality risk per fight is 880 x 0.55 = 484 deaths per billion flights. For a flight of distance d, the fatality rate, r, is

$$r = 484/d \text{ fatalities per billion miles.} \qquad (15)$$

The curve in Fig. 3 is r versus d. Also shown as a horizontal line is the fatality rate for the low-risk driver (eqn 14). For distances to the left of where these intersect (that is, d < 615.8 miles) fatality risk is less for car travel than air travel. Thus, the low-risk driver has a lower fatality risk on trips of less than 600 miles if he drives rather than flies. This represents a

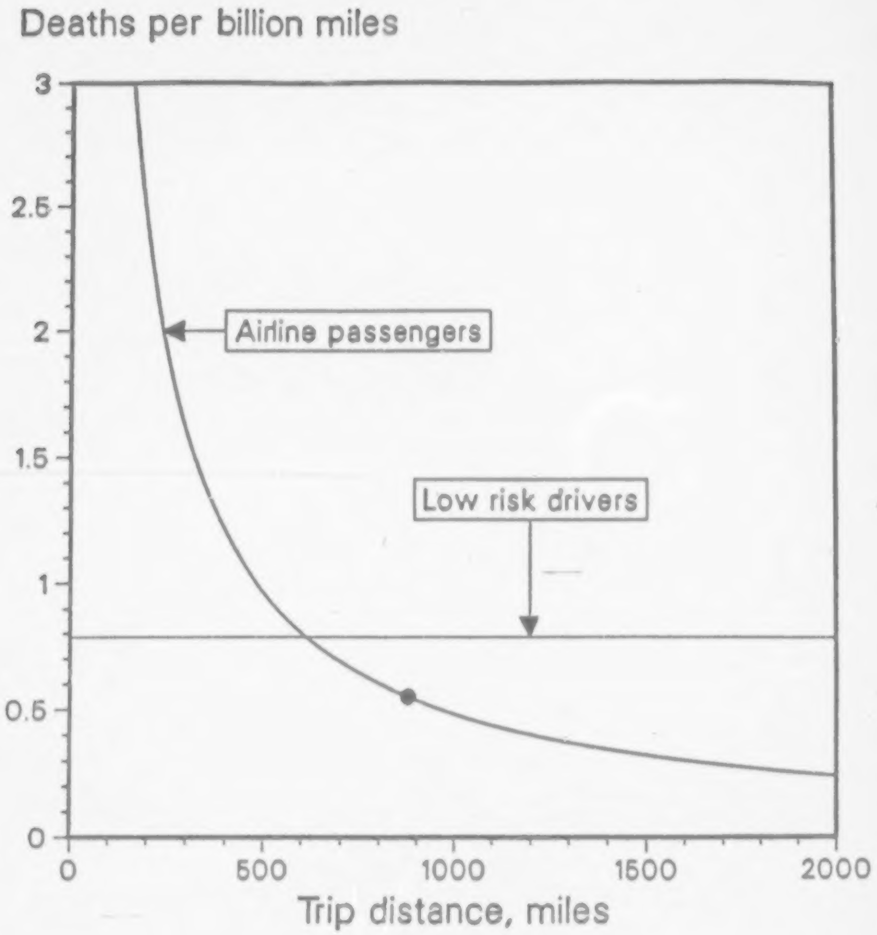


Fig. 3. The curve shows traveller fatalities per billion traveller miles for airline passengers, based on an average rate of 0.55 deaths per billion miles for a trip of average distance equal to 880 miles (indicated by the bullet on the curve). The horizontal line shows the rate for 40-year-old, belted, alcohol-free drivers travelling on the rural Interstate system in cars 700 pound heavier than average. The rate for 18-year-old, intoxicated, unbelted, male drivers travelling average roads in cars 700 pounds lighter than average (604 fatalities per billion miles) is over 200 times off-scale in this representation.

large fraction of all airline trips, and an even larger fraction of those for which a choice between car or air travel might arise.

In contrast, the high-risk driver's (eqn 15) risk of death in one mile's driving, namely 604 chances in a billion, exceeds the chance of death on an average flight, which is 484 chances in a billion. So, once the high-risk driver boards the aircraft he has indeed completed the most dangerous part of his trip; if he drives 35 miles to the airport, his fatality risk getting there exceeds his risk on the flight by a factor of over 40.

Drivers with the same sex and age distribution as airline passengers have an average driver fatality risk of 12.56 x 0.759 = 9.5 driver fatalities per billion driving miles, assuming that the belt, alcohol, mass and road factors are unity; that is, apart from using the age distribution appropriate for airline passengers, the airline passengers are otherwise assumed to have the characteristics of average drivers. Such a fatality rate implies that to equal the 484 chances of death per billion on the airline flight, the driver would have to travel 484/9.5 = 50.9 miles by car. As this is much further than a typical drive to an airport, the fatality risk on the airline portion of the trip exceeds that on the trip to the airport.

CAVEATS

It should be stressed that the comparison has focussed exclusively on car-driver fatalities. Crashes by cars and aircraft injure non-occupants, but the ratio of those hurt outside to inside the vehicle is substantially larger for the car. Also in concentrating on fatalities, we have not addressed the question of non-fatal injuries. Such injuries exceed fatalities by about a factor of 70 in road traffic, but are less numerous than fatalities in airline crashes.

In comparing car and air travel we have made various simplifying assumptions. For example, we have ignored that air travel requires surface travel to the airport, the additional travel not necessarily being in the direction of the destination. The non-rural Interstate portion of inter-city driving probably balances to some extent the trip to the airport. We have not considered any effects due to some inter-city travel involving more than one flight. Overall, we assume that the car and air travel distances between two cities are the same.

Treating the various factors as non-interacting multiplicative factors is an approximation made necessary by data limitations and impracticality of performing a complete multivariate analysis. Unquestionably, interactions exist between some of the terms studied. However, we note on page 6 of Chapter 2 in [7] the fact that the fraction of fatalities involving alcohol does not vary dramatically with age. Detailed examination found no relationship between the car mass effects used here and driver age [24] or belt use [25,26]. Belt effectiveness has been found to be lower for older drivers [27]. Treating the factors as non-interacting may tend to overestimate the fatality risk for the younger driver, and to somewhat underestimate it for the older driver. This might bias upward the trip distance at which airline and car travel fatalities rates become equal. However, other effects are likely to bias it by much larger amounts in the opposite direction. Traffic fatalities have been linked to criminal behavior in general [3,28], and to lower socioeconomic status [29]. Although we do not have specific data, it is our judgement that such contributory factors would be less prevalent among airline passengers than among those contributing to traffic fatalities. Based on the above considerations, we consider that the estimated distances at which airline and car fatality rates are equal are lower than actual.

CONCLUSIONS

This study has shown some of the misleading impressions that can be generated by the use of average values, in keeping with the sentiment expressed in the old adage noted by Feinstein in [30], that statistics are like a bikini bathing suit: what is revealed is interesting; what is concealed is crucial.

We have shown that, contrary to the advice of experts and the views of many analysts, car-trips by many drivers can have lower fatality risk than regularly scheduled airline flights. On the other hand, for other road users the trip to the airport is indeed more dangerous than the flight. More specifically:

1. 18-year-old, unbelted, intoxicated, male drivers of cars 700 pounds lighter than average are substantially more likely to be killed on the trip to the airport than on the flight.

2. Drivers with the age distribution of airline passengers are less likely to be killed on the trip to the airport than on the flight.

3. 40-year-old, belted, alcohol-free drivers of cars 700 pounds heavier than average are slightly less likely to be killed in 600 miles of rural Interstate driving than in regularly scheduled airline trips of the same length. For 300 mile trips, the driving risk is about half that for flying. Hence, for this set of drivers, car travel provides a lower fatality risk than air travel for trips in the distance range for which car and air travel are likely to be competing modes.

REFERENCES

1. S. A. Morrison and C. Winston, The Brookings Review, pp. 10-15, (Winter 1988).

2. R. B. McKenzie, and J. T. Warner, " The Impact of Airline Deregulation on Highway Safety" Working Paper OP68. (Center for the Study of American Business, Washington University, December 1987).

3. L. Evans, Alcohol, Drugs, and Driving, 3, pp.63-78, (1987).

4. R. C. Schwing and D. B. Kamerud, Risk Anal., 8, pp. 127-133,(1988).

5. L. Evans and M. C. Frick, "Seating Position in Cars and Fatality Risk", The Amer. J. of Pub. Hlth., 78, pp.1456-1458, November 1988.

6. National Safety Council, Accid. Facts, Chicago, 1988 Edition.

7. National Highway Traffic Safety Administration: Fatal Accident Reporting System 1987, Document DOT HS 807 360, December 1988.

8. U.S. Department of Transportation, Federal Highway Administration: Highway Statistics, 1983. U.S. Government Printing Office, Washington, DC 20402.

9. Motor Vehicle Manufacturers Association of the United States, Inc. (1986). MVMA Motor Vehicle Facts and Figures '86, Detroit.

10. U.S. Department of Health and Human Services, National Center for Health Statistics: Vital Statistics of the United States -- Volume II -- Mortality, Washington, DC, issued annually.

11. A. Barnett and M. K. Higgins , Mgmt. Sci., 35, pp. 1-21, (1989).

12. U.S. Department of Transportation: Survey data tabulations; 1983-1984 Nationwide Personal Transportation Study. DOT-P36-85-1, November 1985.

13. L. Evans, J. Geront.:Soc. Sci., 43, pp. S186-S193, (1988).

14. L. Evans, "The Fraction of Traffic Fatalities Attributable to Alcohol", General Motors Research Publication GMR-6636, March 30, 1989.

15. R. F. Borkenstein, R. F. Crowther, R. P. Shumate, W. B. Ziel, R. Zylman: "The Role of the Drinking Driver in Traffic Accidents", (Department of Police Administration, Indiana University, 1964).

16. J. C. Fell, C. E. Nash, Hlth. Educ. Quart., Spring 1989, in press.

17. L. Evans, Risk Anal., 7, pp.49-57, (1987).

18. National Highway Traffic Safety Administration: 19-city Safety Belt and Child Safety Seat Use Observation Survey [(for 4th quarter of 1987), Washington, DC, Feb. 1988].

19. L. Evans, *Accid. Anal. and Prev. 18,* pp. 229-241 (1986).

20. L. Evans, *J. Safety Res.*, *18*, pp. 57-64, (1987).

21. W. H. Hunter, R. J. Stewart, J. C. Stutts and E. A. Rodgman, "Overrepresentation of Non-belt Users in Traffic Crashes", *32nd Proc. of the Assoc. Adv. Automot. Med.*, pp. 237-256, 1988.

22. L. Evans, "Car Size and Safety: Results from Analyzing U.S. Accident Data", *Proc. Tenth Intn'l. Tech. Conf. on Exptl. Safety Veh.*, Oxford, England, July 1-4, 1985; (US Department of Transportation, National Highway Traffic Safety Administration, DOT HS 806 916, pp 548-556, February 1986).

23. Air Transport Association of America, *Air transport 1988 - The Annual Report of the U.S. Scheduled Airline Industry*, New York, 1988.

24. L. Evans, *Accid. Anal. and Prev. 16,* pp. 19-36, (1984).

25. L. Evans and M. C. Frick, *J. Safety Res.*, *17*, pp. 143-154, (1986).

26. L. Evans, *Accid. Anal. and Prev.* *17*, pp. 251-271, (1985).

27. L. Evans, "Airbag Effectiveness in Preventing Fatalities Predicted According to Type of Crash, Driver Age, and Blood Alcohol Concentration", Proceedings of the 33rd Annual Meeting of the Association for the Advancement of Automotive Medicine, Baltimore, October 1-4, 1989.

28. M. Sivak, *J. Safety Res.*, *14*, pp. 93-99 (1983).

29. Office of Population Censuses and Surveys. Information from the Registrar General's Decennial Supplement on Occupational Mortality, 1970-1972, (Series DS No. 1, Her Majesty's Stationery Office, London, 1978).

30. A. R. Feinstein, *Science, 242,* pp. 1257-1263, (1988).

31. We thank Marge Shepard of the General Motors Research Laboratories library, who tenaciously tracked data sources and much background material that contributed to this study. Illuminating discussions were held with Stan Smith of the National Transportation Safety Board, who provided print-outs of information on recent air crashes. Sharon Clanton, of the Biometrics Branch of the Centers for Disease Control, provided a computer disk of ICD E840 code fatalities from which we extracted the information on ages of airline fatalities; this could not have been done without her help and that of Richard Waxweiller, Head, Epidemiology Branch, CDC.

Congressional Subcommittee on Aviation
2167 Rayburn Building
Washington, D.C.
July 12,1990

Good afternoon, Members of the Committee.

I am Adele Cover. It is a privilege to be here to present my views as a family member among the flying public. I am a mother and a grandmother, and I am also a fairly savvy consumer.

The May 23 Washington Post article titled "NTSB Recommends Adoption of Airline Child-Safety Seats," triggered my consumer-alert focus with its subtitle, "Era in Which Baby Rides on Lap for Free May Be Over."

I then submitted the following letter to the Editor of The Washington Post which was printed on June 2:

"ONE HALF $$BILLION AIR FARE RISE"

"'The National Transportation Safety Board recommended yesterday that the government require all infants and small children be placed in child-restraint seats aboard airliners,..' (Washington Post - 5/23/90).

"Take out your calculators folks. That same article said that between 5,000 and 10,000 children under 2 travel on airliners every day. Figure between $100 and $200 per fare, and it is pretty easy to come up to well over $500,000,000. This money would go right into the airlines' pockets, and be paid by mostly young parents.

"What in the world ever happened to cost effectiveness? How many lives might be saved? I've seen no estimates. There are always plenty of estimates of lives saved if we drive a car at a certain speed, use seat belts, or have air bags in our cars; why no estimates now? Maybe a few lives might be saved over a period of many years. How many more might be saved if that much money were invested in better radar and computers for airports.

"The subtitle of the article was: 'Era in Which Baby Rides on Lap for Free May Be Over'. Is this what it's really about; money, not safety?"

With the preceding letter as a background, I respectfully submit to the members of the Congressional Subcommittee on Aviation the following:

- If it can't be shown that a significant number of babies' lives will be saved with the use of safety seats, then the use of safety seats on airliners should not be made mandatory. It is absolutely unconscionable to extract millions of dollars from parents who don't want to purchase unneeded "protection".
- Safety seats should be made available for parents who wish to use them for their babies. In this instance, parents would be required to pay the extra air fare for their baby's ticket.

Through the legislative process, if an attempt is made to minimize the appearance of a large fare rise for young traveling families, please consider the following:

- Ticketing based on stand-by or any other last-minute arrangement would be unacceptable for families flying with babies. Planning and timing are absolutely essential to traveling with little ones.

Thank you for your time and interest in allowing me to share my views with you today.

Adele Cover
12533 North Lake Court
Fairfax, VA 22033

Before The Subcommittee On Aviation
House Committee On Public Works And Transportation

Life, Liberty, And The Pursuit Of Happiness Is This Denied From Birth Until Two Years Of Age ?

For Hearing On Legislation Mandating Use Of Child
Restraints On Commercial Aircraft

Testimony Of Lori R. Michaelson
Survivor Of UAL Flight 232 Crash July 19, 1989 In Sioux
City, IO And Mother Of Sabrina (11 Mos. Old @ Time Of
Crash Who Was Lost In The Wreckage And Later Found Alive)

Lori R. Michaelson
7976 Hunters Ridge Dr.
West Chester, OH 45069
(513) 779-8860

Mr.Chairman and Members of the Committee:

Thank you for giving me the honor of appearing before you and being able to testify on an issue that has been of the utmost importance to our family this past year.

My name is Lori Michaelson. My husband Mark, our sons Doug (6), Andy (4), our daughter Sabrina (11 mos), and I were among the 184 survivors of UAL Flight 232 that crashed in Sioux City, Iowa on July 19,1989 in which 112 people lost their lives. We were in the process of moving from Denver to Ohio.

Prior to this flight, I did not give much thought to the policy of having a baby in my lap during a flight. Now I feel the risks of injury or death posed by the practice of allowing "lap babies" is real. It also justifies the need to mandate child restraints for children under two years of age traveling on airliners. At present, until this is mandated, parents bringing their children onto the aircraft unrestrained, need to be able to make an informed decision about the danger they impose on their children when they have a "lap baby". The time for keeping this reality hushed is over.

The National Transportation and Safety Board has been quoted as saying 80% of large commercial aircraft crashes that manage to land, are survivable. The logic I have heard some of the public use for not buying a seat for their infant has been that they all will probably die if the plane crashes. This belief is not true, therefore in light of this fact, shouldn't our infants have as much of a chance at survival as the adults and older children?

The crash of Flight 232 amazed everyone with the number of survivors. I feel the need to cite some specific situations that happened on 232 in relation to the four passengers listed as infants on board. By doing this, you can better appreciate the importance of the legislation we look at today. The following scenarios demonstrate without question why this bill must be passed.

Imagine watching your 23 month old float to the ceiling and then travel at a high rate of speed towards the rear of the plane. This is what the mother has to relive as a last memory of her little boy who was killed in UAL 232.

Imagine the parents of another 23 month old, who was sitting on the floor between them,each holding onto one of this little boy's arms, fighting the forces of a crash landing at 200 mph that threatened to rip his arms from his body, or more likely, throw him from their grasp.

Imagine another 23 month old, at point of impact, being grabbed in mid air by his young mother, but not before sustaining bumps to his head and body from hitting the sides and ceiling of the plane.

And in our case, having our 11 month old baby screaming, while being held on the floor, after being awakened from a nap, as a crash landing was to definitely take place. Picture me, a person only 5'3", trying to bend over to reach the floor to hold onto my baby; a task that was almost physically impossible. Then picture the vulnerability that I felt, having one hand on my daughter, and holding blankets and pillows over her head with the other.(This crash position was a change from what I was initially told, which was to hold her in my lap.) There has never been such a feeling of helplessness and terror in my life.

Imagine being so consumed by our baby's vulnerability and sure fate that our 4 and 6 year old sons were not able to get the support from their mother or even the last parting words that they deserved.

Isn't it curious that "lap babies" are also called "missiles" in airline lingo. How descriptive of their possible destiny.

The crew did a magnificent job in the handling of this emergency situation, but we do fault the FAA for not making more clear cut policy for emergency situations.

Would you feel secure with the current measures to protect your baby? We had to get the attention of a flight attendant from the aisle, and ask her how to best protect our baby. I can still remember the look in her eyes, as we both knew this baby had a slim chance at surviving the crash landing. To know in your gut that all these measures surely would not have any chance of affecting the ultimate outcome is overwhelming.

Then know the sickening feeling of realizing our baby was being sucked out of my grasp as the plane flips over, and the feelings of the tremendous forces involved. Go through the mental imagery of her fate and the knowledge of knowing I had to get two other children away from the plane to safety.

Imagine her father, my husband, hearing the cry of his infant daughter once, and not being able to find her amid smoke and flames, being finally forced to abandon his efforts knowing she may still be alive. He could have easily lost his life searching for the baby.

I wonder how many others of this and other crashes have lost their lives going back into the wreckage to search for the cries of lost children ?

It is only due to thanks to God that our daughter survived and not to safety measures used in our emergency situation.

Our daughter Sabrina was found by another passenger, Jerry Schemmel, who had already gotten outside of the wreckage, and went back in, after hearing her cries. Luckily she was concious and able to cry out, allowing Jerry to hone in on her location. She ultimately ended up in an overhead storage bin which was now on the floor, approximately 15 rows to the rear from where our original seats had been.

Since the crash I have been working with the media both locally and nationally on the issue of making infant restraints mandatory on airliners. I feel it is the one POSITIVE thing I can have a part in from this terrible ordeal. Also everyone involved hopes for improved and safer plane design. I encourage the Members to read the Airline Pilots Association," Analysis and Recommendations Regarding Flight 232". Please heed their suggestions. They are the ones in the skies when disaster strikes, not the FAA officials.

I am making a plea to the Members to vote to make it standard policy, that all children be restrained during a flight, not just the adults and older children. In a quote from Nora Marshall of the NTSB from USA Today on 5-23-90, "Everything in the cabin, from a coffee pot to your carry-on luggage, has to be restrained, except children under two." How much sense does this make?

In February of this year the Air Transport Association publicly stated child restraint systems were the safest way for babies to travel. Why is it I still here of the hassles parents are getting at the gates, even when they have purchased a seat?

At present, it is not fair to put the burden of making children safe in the skies on their parents. It is up to the FAA to make sure that air travelers are as safe as they can be, ALL of them. This is especially true with an emergency landing or the more frequent occurrence of turbulence.

The FAA argues that a Harvard Medical School study suggests only three children would be saved in a ten year period if safety seats were required. Is the overall conclusion at FAA, of three children being killed, taken to be an "acceptable level of risk"?

At present, assuring passenger safety in regards to children under two means it is up to fate and luck if the plane encounters turbulence or crashes as Flight 232 did.

I am also a Registered Nurse. Would it be acceptable to Congress for a Doctor or a Nurse to consider a patient as an" expendable package" before the patient reaches the age of two?

From the economic standpoint, FAA has argued that parents should not be required to buy a seat for their infants because the expense might cause them to drive instead istead of flying. Do they know this for certain? It assumes the airlines have no imagination, no vision, and no empty seats on any flights. In fact, airlines could schedule flights with free seats or half price seats for children, just as they do for senior citizens. I am sure the marketing departments would create competition between airlines that would probably result in the customer being the beneficiary in cost and safety. Who wouldn't want to be known as the safest airline for kids, and not just the official airline for kids as one T.V. advertisement states.

It is time for Congress to tell the FAA that America has the same standard for voting and flying:" one man, one vote; and one passenger, one seat on airplanes."

Children don't vote, but their parents do. No parent wants to pay more for a seat on a plane than they have to. On the other hand, no parent wants to experience what we did on Flight 232 when the plane crashed.

Thank you for your time and hearing my views on this issue. God bless and may you all have uneventful flights.

STATEMENT OF CHRISTOPHER J. WITKOWSKI
DIRECTOR, AVIATION CONSUMER ACTION PROJECT

before the
Subcommittee on Aviation
Committee on Public Works and Transportation
U.S. House of Representatives

Washington, D.C.
July 12, 1990

Mr. Chairman and members of the subcommittee:

On behalf of the Aviation Consumer Action Project (ACAP) I appreciate this invitation to testify about the need for child safety restraints aboard airliners. ACAP was founded in 1971 and is the only non-profit consumer organization working fulltime on aviation matters.

ACAP strongly supports the proposal to require that infants and small children be restrained in approved child seats during airliner takeoffs, landings and in-flight turbulence. Clearly, the nation's youngest and most vulnerable airline passengers deserve the same protection that has long been required for adult passengers.

Under current law, children under the age of two are the only passengers that need not be restrained during takeoffs, landings and turbulence. Even carry-on baggage must be securely stowed at these times.

Experts tell us that despite the best of intentions, a parent or other adult may be incapable of restraining a child in their lap during an accident or severe turbulence. Dr. Jerry Snyder of BioDynamics International reported that adults who hold children in their laps can provide "virtually no protection at all in the impact deceleration of a crash, or even in severe turbulent inflight. The child literally is at risk as a free-flying, unrestrained missile." The National Transportation Safety Board has called it a "major contradiction" of FAA regulations for these youngsters to be unrestrained when all other so-called "items of mass" must be secured. The board warns of the risk this poses to both the infants and to others.

Recent accidents in the aviation industry provide graphic illustration of the consequences of this gap in airline safety procedures:

--The most recent infant fatality occurred on January 25th, 1990, when Avianca Flight 52 crashed on approach to Kennedy International Airport in New York. One parent was buckled in and survived the crash, but her lap-held baby did not. Six other unrestrained infants between the ages of four months and 18 months were seriously injured.

--Also this past January, an American Airlines DC-10 encountered turbulence at 18,000 feet while descending near San Juan, Puerto Rico. An unrestrained seven-week-old infant suffered severe head injuries and was hospitalized. The child was the only passenger to suffer serious injury.

--In the United Airlines crash last summer in Iowa, an unrestrained 23-month-old baby was killed and three others sustained minor injuries. During preparations for the emergency landing, parents were instructed to place their infants on the floor and to hold them there when they assumed the "brace" position. The mother whose child died reported that she followed those instructions, but that she was jolted upright by the impact of the crash and her son went "flying" toward the rear of the cabin. The mother escaped unharmed, but was unable to reach her son and carry him to safety.

As a consumer group that works for competitive and reasonable fares as well as aviation safety, ACAP is keenly aware of the cost considerations related to a child restraint requirement. Some parents may worry that they will not be able to afford to fly if they must purchase an additional ticket for their infant. ACAP, however, believes it is possible to provide this important new safety protection without imposing a prohibitive economic burden on parents with young children.

Currently, U.S. carriers do not require parents to purchase tickets for their lap-held babies. In addition, the airlines allow parents to set up child restraint seats at no charge if there are vacant seats available. This is often the case, since the vast majority of airline flights are not fully loaded. Some industry experts estimate that no more than 5 percent or 6 percent of airline flights are full.

Ideally, the airlines would make similar provisions for infants to fly for free even if child restraints were mandatory. Certainly, there are any number of inducements and fares that they could offer to keep these infants and their families flying. We believe that airlines could set aside a certain number of free seats for infants on off-peak flights and those that are consistently underloaded. On flights that are likely to be fully loaded, airlines at most should charge highly reduced "infant" fares, lower than those for children from ages two to 12.

The FAA estimates that 4 million children under the age of 2 fly with U.S. carriers each year, each of them accompanied on average by two adults and one other child between the ages of three and five. Ever since airline deregulation, U.S. carriers have offered an ever-changing menu of fares designed to attract and hold the loyalty of their passengers. It is unlikely that the airlines will sacrifice large numbers of family customers, who pay substantial fares already, by charging prohibitive fares for the infants who now fly for free.

I would like to address briefly two recent reports that predict a net safety loss if cost-conscious parents choose to drive rather than fly with their infants. Both are based on assumptions that ACAP believes lead to unfounded conclusions.

A paper cited by the Competitive Enterprise Institute predicts that a child restraint requirement would force many families back on to the nation's highways, where travel would be more hazardous than by air. However, this report by professors Richard McKenzie and Dwight R. Lee relies on FAA estimates that airlines will charge half-fare for all infants and experience an 18 percent drop in infant boardings. We find it doubtful airlines would set fares so high as to drive away the adults attached to nearly one-fifth of all infant boardings.

The paper also uses national statistics on highway accidents, injuries and deaths which include high-risk groups such as unmarried young men and intoxicated drivers. This fails to recognize that accident statistics are likely to be considerably lower for parents traveling with young children.

A second report that raises the possibility of higher traffic deaths and injuries if child restraints are required on airliners was submitted to the FAA by Apogee Research Inc. of Bethesda, Md. This study makes the assumption that airlines would charge infants a fixed percentage of full coach fare or the full cost of an advance purchase ticket if any are available. However, the study notes that lower fare increases for infants would cause fewer families to abandon or reduce air travel and would increase the expected number of lives saved.

One other issue related to a mandatory child restraint requirement is the question of who would provide the safety seat. Many parents now own child restraints seats that are approved for use in aircraft as well as autos. These parents should be allowed to use their own restraint seats during flight. Other parents who come to the airport by limousine, taxi, public transportation or from foreign countries probably would need for the airline to provide them with an infant seat. Airlines could provide these at no charge or at a minimal fee when parents request them at the time they make their reservations. For example, many car rental firms provide child seats for about $3 a day. The fee covers all of their costs to provide and sanitize the child restraints as well as some additional profit for some of the companies.

Mr. Chairman, ACAP believes there is no reason not to require that infants be properly restrained on board airliners just as they are in automobiles. ACAP has received many letters from consumers advocating mandatory child seats. As one woman so eloquently wrote, "This is a country of choice. As adults we choose ways to keep ourselves safe. But until our children can decide for themselves, it is up to us to keep them safe."

I urge the subcommittee to approve legislation that will help make mandatory child restraints a reality on U.S. airlines. Thank you for the opportunity to address you on this subject.

TESTIMONY BEFORE

THE HOUSE PUBLIC WORKS AND

TRANSPORTATION SUBCOMMITTEE ON

AVIATION

BY

STUART R. MILLER

HEARING ON MANDATORY CHILD RESTRAINT USE ON AIRCRAFT

JULY 12, 1990

Mr. Chairman and members of the committee, GOOD AFTERNOON. I am Stuart Miller, the first advocate for infant/child safety aboard aircraft. My crusade began 19 years ago and I have been motivated not by money, publicity or personal gain, but from meeting the face of death, eye to eye, with my own son.

I pioneered the development of the first infant/child restraint system for use in both general aviation aircraft and for commercial air carriers. I hold the first and only supplemental type certificate for such a device as well as obtaining the only parts manufacturing approval, which was issued under the strict control of the FAA. I have never nor will ever accept any compensation for this safety device. I personally created installation procedures as well as conducted the installation of infant/child devices on aircraft from a C-172 to the Concorde. For the record - any one can purchase a proper approved device without a problem at a reasonable price.

Over the past years, several of my proposed mandatory rule changes have been submitted to the FAA. In fact, the FAA informed me in writing that, (Quote) "A rulemaking project is currently in progress that would permit the use of child restraint devices aboard U.S. registered civil aircraft". "Due to the advanced status of the current project, we request that you withdraw your petition in order that the agency may avoid delay". The date of this letter was April 2, 1976, signed by Arthur E. Pearsall, Chief, Air Carrier Regulations Branch, Flight Standards Service, FAA.

Many of my other adversaries have now concluded, and agree with my early findings, that a definite and irrevocable need exists to protect infants and children up to 3 years or 40 lbs. in an approved safety seat aboard aircraft.

Our differences are between my mandatory concept vs. the FAA's voluntary rule.

History has again proven the FAA wrong. Their misjudgment was the implementation of a voluntary program March 5, 1985, when the Secretary of Transportation and the FAA made their joint announcement. At that time the FAA stated that (Quote) "36 models totaling more than three million seats were acceptable" for aircraft use.

By waiving the new FAA standard (Technical Standard Order C-100), after years of special and costly research at the tax payers' expense, the Secretary combined the National Highway Traffic Safety Administration standard which added six million more devices available for air travel use. This figure was quoted from the FAA release of Tuesday March 5, 1985. (DOT 19-85)

The FAA stated "After extensive testing and evaluation, the FAA has determined that an estimated six million additional child safety seats approved by NHTSA are acceptable for use in both airlines and general aviation aircraft, during all phases of flight". This change became effective February 26, 1985.

Furthermore, the FAA stated (Quote) "While the new policy does not require air carriers to allow the use of child seats, at least 16 major airlines already permit the use of such FAA-approved seats".

I now will read excerpts from the DOT release. The purpose is to show how the DOT and the FAA "in my opinion" were deceptive in their statements for the benefit of their relationship with the air carriers.

"It will be much easier for the airlines to identify child seats approved by the FAA," Dole said. "With this simplified policy, we will encourage more air carriers to permit passengers to use approved child safety seats.

"We encourage families traveling by air to protect their children with safety seats before, during and after the air travel portion of their trips". Administrator Donald D. Engen of the FAA is providing the airlines with detailed information about the new policy and urging them to allow passengers to use child seats.

Dole said the use of infant seats for those up to age one in motor vehicles is now about 69 percent, and the use of toddler seats for those aged one to four is about 47 percent.

The FAA was never able to satisfy my inquiries on this subject. It is obvious that their use of expensive prestigious research studies and tests are "loaded" to reach predetermined economic answers.

Therefore we should not and cannot rely on any reports which the FAA may have presented in the past.

For example, the FAA stated "After extensive testing and evaluation". Of course if you demand proof that's another story.

Tests were conducted at CAMI, Oklahoma City, by Richard Chandler in the early 1970's, as well as a quick fix test conducted at Calspan, Buffalo, NY, for DOT, on a few specific devices after it was known about my S.T.C. being granted and TSO C-100 was issued.

These tests were a blatant waste of tax payers' money. The tests were conducted with a very narrow population of child devices.

I stated my objections shortly thereafter, to no avail.

With all the noise and great promises by the FAA, it is a proven fact that what remains is an unsuccessful voluntary program with infants and children still flying without proper protection.

Although the ATA is now jumping on the wagon, they have stated that there are not enough infant/child safety devices available for use on aircraft and have suggested that an AD HOC committee be formed to study the situation for at least another year.

It is hard to conceive, with the pounds of letters and other materials which I have generated plus the FAA, NHTSA, NTSB and others have poured out, that a professional organization would make such a ludicrous and unconstructive statement that there were not enough child devices which fit on airlines, unless it was their intent to delay child safety for a few more years.

This brings us to the next controversial topic and now the only FAA objection, which is cost.

First, we must consider the actual cost of each child restraint device. In the past and currently, the FAA established a price per unit; how they obtained this information is unknown. In checking a number of retail stores and catalogs, the cost to a retail consumer can be as low as $35 to a high of $75. However, this can be misleading. An airline can purchase a number of devices at a discount and perhaps a non deluxe unit at $40, with spare parts.

The FAA has never shown this cost on a "cost amortized basis over the projected life of a unit." For our discussion, I will use a five year estimate. This is a high value because the devices are made of a long use plastic shell, padding and belts. (Note that there are few moving parts; truly a simple device!) Thus, using $40, over five years we have a cost per unit of $8 per year. Taking this $8 cost another stage, we should consider a $2.50 factor for a service cost for cleaning and reserve per the number of passenger usages (figure used by car rental business). Compare this with the cost of food service per passenger and in some cases free newspaper, reading material and children games. One might say we should carry on our own blanket and pillow now provided by the air carrier. Examine the cost of supplying wine, beer and liquor.

A choice the airlines can always make is to provide the devices free, to be included in their pricing of tickets or to charge a rental charge.

I envision a cooperative pool of devices at each airport which would supply the devices for each flight. In fact, a service organization might even be formed on the same basis of outside food contractors. There are alternatives which can be selected by each air carrier.

The FAA has been unable to present bonafide figures. Even with the use of outside prestigious consulting firms I find that their basic hypothesis and statements of studies are directed and false.

None of the information I have seen from the FAA has been based on actual physical polls or interviews with a large accurate public sample. Obvious factors have been omitted from every FAA report, such as competition, free economy, and time/distance or consideration, and psychological attitudes and motivations of parents concerning flying in relationship to the safety of their children. The use of statistics from other industries in an attempt to substitute actual data from the airline industry is an inaccurate research method. The recent "Executive Summary" study circulated by the FAA is based on many fallacious fundamental hypothesis.

An example is the attempt to correlate air safety per mile versus automobile safety. The false assumption is that if a mandatory rule is enacted this will force more two year olds and under and their families to travel by car which is, according to the FAA, more dangerous. We know that all our states require infant/child seats for auto use. Secretary Dole used a figure that 500 small children die in auto crashes each year. This was her reason for working for enforcement and passage of an all-state mandatory auto use rule. Of course I could never find out the death by age in her quote.

The FAA can not substantiate the switch from air to ground. No time versus distance displacement factor was even considered. It is highly unlikely that a family would drive from Boston, New York, or Teaneck, N.J., to visit grandparents or Disney in Florida for a vacation in place of flying.

The FAA failed to consider the cost of food, motels, fuel, tolls, auto repairs or the time lost for a round trip vs. a free airline ticket or perhaps a ticket of $29.00 (Eastern Airlines) fare.

This is another foolish attempt to confuse this committee and the public. The people which I interviewed laughed when given the choice of air, car, bus or train.

Driving was the last choice; and has the FAA forgotten about the horse? In respect to the members of this committee and our limited time, I will reserve comment on this point at this time.

This entire report was created in an attempt to comply with "Executive Order" 12291, of February 1981. Executive Order 12291 has many grey areas which lead to confusion.

However, under Sec. 8-page 708 exemptions: (1) "Any regulation that responds to an emergency situation provided that, any such regulation shall be reported to the director as soon as is practicable, the agency shall publish in the Federal Register a statement of the reasons why it is impracticable for the agency to follow the procedures of this order with respect to such a rule, and the agency shall prepare and transmit as soon as is practicable a regulatory impact analysis of any such major rule".

An emergency does exist for every infant/child flying without proper restraint. We don't let adults travel without seat belts and we have proven that death is just as final for infants and children as is for adults. The FAA has lost their priority and placed unproven cost guess work in place of safety. I declare an emergency and demand that the FAA Administrator take direct intervention and pass a mandatory rule change.

It is time that the Administrator reassigns Anthony J. Broderick, Associate Administrator for regulation and certification, at once to a position which is less sensitive to Aviation Safety and the loss of human life. After his work on child safety and counterfeit aircraft parts, I think he should be advised to take early retirement.

(2) The Director, subject to the direction of the Task Force, may in accordance with the purposes of this order, exempt any class or category of regulations from any or all requirements of this order.

The aforementioned paragraph would allow the FAA to avoid any further delay and pass a needed mandatory regulation.

If we look at the regulation as I proposed as a new service now provided to the public by the airlines, of course (since there has been no history on this new service), a price structure must be created. Whatever this initial price may be, you can be sure free unregulated airline prices will change as influenced by competition.

Basically, the air carriers are providing a service either new or existing because they are transporting that two year old or younger child from one place to another. Thus they are entitled to charge, if they wish, for the service they provide, just as in the case of a two year old plus one day.

Arguing over this two and three year matter when safety is concerned is fool-hardy on the part of the FAA because their mission is safety!

ACCOUNTABILITY

The public is now seeking accountability from corporate executives and from public officials. Individuals who are responsible for human life and safety must be held accountable for their actions. Recent Supreme Court decisions have shown a trend in support of this aforementioned concept. Thus, in the event of the next infant or child's death in a survivable air crash,

in which the infant is unrestrained, the airline president who's aircraft is involved in that future crash and a FAA official such as Mr. Broderick should be accountable for this death and should be indicted for criminal negligence to commit manslaughter and for discrimination against children for not providing equally safe flight.

My opinion is based on the fact that both entities are aware of the scientific evidence and that FAA-approved child restraint devices are available for aircraft use.

ACTION TO BE TAKEN

MR. CHAIRMAN AND MEMBERS OF THIS COMMITTEE, IT IS YOUR RESPONSIBILITY TO PROTECT OUR FLYING CHILDREN AND FORCE THE FAA TO ADOPT THE PROPOSED RULE CHANGE.

Proposed rule making change:

"All infants/children up to 3 years old shall be required to be seated in their own seat, within an F.A.A. Certified Infant/Child Restraint System meeting TSO C-100 or equivalent for take offs and landings and/or at such times that the pilot in command deems it necessary". Public Docket (No. 25985)

Stuart R. Miller
Box 926
Grand Central Station Post Office
New York, New York 10163-0926
201-836-2460

BioDynamics
International
Scientific Research & Consultation

Richard G. Snyder, Ph.D., DABFA

3720 N. Silver Drive
Tucson, Arizona 85749
(602) 749-2699

July 6, 1990

Congressman Jim Oberstar
Chariman of the Sub Committee on Aviation
The Public Works and Transportation Committee
2165 Rayburn House Office Building
Washington, D.C. 20515

Dear Mr. Chairman,

As a scientist who has conducted research on occupant crash protection for over thirty years, I strongly support the position that the Federal Aviation Administration amend the FAR's to require that approved (FMVSS 213) infant and child restraints be manditory for air travel.

Infants and children clearly represent a large neglected population as aircraft passengers. A lap-held infant or small child must be considered an unrestrained flying missle in the event of a crash impact. Tests conducted at the University of Michigan sponsored by the Insurance Institute for Highway safety documanted that even low level inertial forces may be beyond the physical limits of the parent to lap-hold the child.

Our infants and small children presently do not have equal protection as aircraft passengers with adults. In air carriers the flight crew is required to be protected by lap belts, shoulder harnesses, and inertia reels. The cabin flight attendents are often in rear facing seats located by an emergency exit and protected by lap belts, double shoulder harnesses, and inertia reels. Passengers are still protected except in rare instances, only by lap belts, under regulations established nearly 40 years ago, yet infants and children are allowed under present regulations to be lap-held without any restraint protection at all.

Infants and small children are provided best protection in approved restraint devices which have been designed and dynamically tested for them. From a protection point of view there is no comparable alternative. This has been a matter of expert discussion on aviation safety community committees such as the Society of Automotive Engineers for the past 30 years.

The unrestrained infant or small child is at much greater risk of death or injury than the adult when exposed to a crash impact, as well as hazards including decompression, turbulance, emergency egress, or ditching. The resulting economic questions posed should be resolved separate from the proven life-saving benefits of infant and child restraint.

The attached status report provides my discussion of this issue in much greater detail. It was presented at the Flight Safety Foundation International Aircraft

Occupant Safety Conference and Workshop, sponsored by the Federal Aviation Administration in the Fall of 1988 and published in August 1989 (1). This represents background which may be helpful to your deliberations and which I request be appended as my submission to this Hearing.

My background for these opinions is based upon over 30 years of conducting and managing research including infant and child impact tolerances and protection- with the Federal Aviation Administration, Civil Aeromedical Institute, and Chief, Physical Anthropology, and Acting Chief, Protection and Survival Laboratories- with Ford Motor Company, as Manager, Biomechanics Department, Automotive Safety Research Office, Engineering Staff- as Head, Biomedical Department, The University of Michigan Transportation Research Institute- and at various other Universities, resulting in some 400 publications and presentations, many related to occupant crash protection.

In addition I have been a member of the Society of Automotive Engineers (SAE) S-9 Air Transport Safety Cabin Provisions Committee for some 31 years, which has considered infant and child restraint requirements for 3 decades, and I was sponsor of both the infant and child restraint Aeronautical Recommended Practices (ARP's) for Air Transport Aircraft. More recently, as a Fellow and member of the Aviation Safety Committee of the 4000- member Aerospace Medical Association, sponsored the May, 1990 resolution(2) on aircraft infant passenger restraint supporting the required use of approved infant restaints in aircraft. This communiaction represents my own personal opinion as a scientist, rather than any particular organization. I hope that the attached material may be useful to your committee.

Sincerely,

Richard G. Snyder, Ph.D., D. ABFA
President

Professor Emeritus of Anthropology;
Research Scientist Emeritus
The University of Michigan

Encls: (1) Snyder, R. G. "The Status of Infant/Child Restraint Protection in Aircraft Crash Impacts". Proceedings, International Aircraft Occupant Safety Conference and

Workshop, Flight Safety Foundation, Sponsored by Federal Aviation Administration. Final Report, DOT/FAA/ 89-2. August 1, 1989 (Revised)

(2) Resolution. Aircraft Infant Passenger Restraint. Aerospace Medical Association. 15 May, 1990.

FLIGHT SAFETY FOUNDATION
FSF

INTERNATIONAL AIRCRAFT OCCUPANT SAFETY CONFERENCE and WORKSHOP

Proceedings

Arlington, Virginia, U.S.
October 31 — November 3, 1988

Final Report
DOT/FAA/OV-89-2
August 1989

Sponsored by
U.S. Department of Transportation
Federal Aviation Administration

The Status of Infant/Child Restraint Protection in Aircraft Crash Impacts

Richard G. Snyder, Ph.D.

In the past few years increasing attention has been given to infant and child protection and usage in automotive vehicles. And at present, (34+D.C) states, all 10 Canadian provinces, and 40 countries, now have restraint use laws. In the Unites States as of January 1988, child use rates have been reported to vary from 28% (Idaho) to 65% (NC) with reported fatality reduction to 32% (Iowa) (1). In contrast, progress has trailed in aviation and there is no body of information as yet as to either usage rates or any injury reduction afforded in aircraft by infant/child restraints.

The reason for the emphasis in automobiles can be seen in the gross statistics. Overall in 1986 (the latest National Safety Council data published), there were some 47,900 deaths and 1,800,000 injuries related to motor vehicles, but only 1029 fatalities in aviation (3 in air carriers, 64 in air taxi, and 958 in general aviation)(2).

Children make up a significant portion of the U.S. population. The most recent census data show that there are 48.4 million children under age 14 in the United States, and 18.1 million under age five (3). In the original National Highway Traffic Safety (NHTSA) notice of proposed rulemaking for child restraints, it was pointed out that approximately 1,000 children up to age 5 are killed, and 100,000 injured in car accidents yearly (4). There are no similar data for aviation.

ACCIDENT EXPERIENCE

In aviation the focus of child and infant restraint usage has been in regard to air carrier operations. But airline crashes involving infants have not been numerous enough to provide a valid body of data, nor has there been much information available on children or infants in most accidents when they have occurred. In many air carrier crashes, children under two years of age may not occupy a revenue seat and therefore might not have been listed, and also there is a lack of complete human factors and biomedical analysis for most accidents to date.

The most tragic air disaster involving children occurred April 4, 1975, when a military Lockheed C5A transport evacuating personnel from Saigon crashed (Operation Babylift). There were about 330 occupants aboard, of which 155 were fatally injured. Of 247 orphans, 98 infants and children were killed. However, due to the wartime circumstances accurate investigation of seated positions and degree of restraint for very few are known with any degree of accuracy, and injury data are primarily documented for survivors (5,6).

On 28 December 1979, a United Airlines McDonnell Douglas DC-8-61 crashed in Portland, Oregon, in which three of the ten fatalities were

Typo errors in original corrected
in this copy. RGS

children under two years (although the severity of the crash was such that it might not have been survivable at the location the children were seated, even with restraints.) A total of six "infants in arms" were involved resulting in three fatal, one serious, two minor injuries (7).

On November 15, 1987, a Continental Airlines aircraft crashed in Denver. Of a crew of five and 77 passengers, the two pilots, the forward flight attendant, and 25 passengers were killed. Three children and two unticketed lap-infants were aboard (8). One child and one infant received fatal injuries. In row 5 (first coach row directly behind the bulkhead) a 2 1/2 year old boy was killed in the window seat (left side), as was a six month-old infant being held by his 22 year old mother (who survived) next to him. The infant received multiple blunt impact injuries including basilar skull fractures and thorax injuries. NTSB investigators concluded the infant was thrown into the bulkhead as a 7 by 4 inch cloth imprint was found in the right side of the neck which matched the fabric of the bulkhead. However, it could not be determined which seat was 5C and whether the seat also failed. The only person in this accident with no injury was a six month old infant held in his father's lap in the middle seat of the very last row. His father reported that he "tucked the baby into his midsection" and bent forward to protect, which in this case was successful. However, note that the crash forces and environment in the rear were much more favorable than in the 5th row (8).

In-flight turbulence may also pose a hazard to unrestrained children. On May 28, 1985, Eastern Airlines Airbus 300, 530 NM north of San Juan, Puerto Rico, flew through the top of a thunderstorm and encountered sever turbulence, resulting in two serious and 19 minor injuries. An eight-month old baby received a minor injury when he was thrown out of its mother's arms, landing ten feet away on the floor without reported injury. In addition, a six-year old girl was thrown to the floor, resulting in knee abrasions (9).

Other cases are also isolated and often it has been difficult to reconstruct sufficiently to determine survivability had the child been restrained with a child/infant seat. Neither FAA or NTSB data banks have been programmed in the past to factor-in infants and children, and injury and fatality figures in general aviation are not known.

Possibly the only published attempt to date to analyze increased risk for infant air passengers in U.S. and world-wide air carrier fatal accidents was a 1981 Harvard Medical School epidemiology study of all air carrier accidents between 1976-1980 having survivors and fatalities (10).

During that périod U.S. air carriers were involved in 21 accidents, three of which had no survivors. In 11 accidents 493 passenger deaths occurred and in four of the 11 accidents children (infants) were aboard. In the U.S. accidents five infants died and seven survived. World-wide, nine infants died and seven survived (48 non-infants died and 278 non-infants survived). In this study the 1976 Portland, Ketchikan, and St. Thomas crashes were treated as four aircraft since each compartment of each crashed plane was treated as a separate crash in the analysis, (M-H risk rates), thus the Portland rear (in which three infants survived), and front compartment (three infants died) were treated separately. The Portland crash was the only accident in this series in which all injuries were due to impact deceleration. Crashes were also excluded if there were no survivors or no infants aboard, and crashes were excluded in which deceleration was not a factor. The hypothesis examined was that infants held on the parent's lap fare worse than do non-infant (belted) passengers.

There were five infant passenger deaths in survivable crashes of U.S. carriers in the four-year period 1976-1979. Results of this study show that if infants and adults both have the adult passenger risk, the expected number of infant deaths would have been 2.42. However, it was found that there were 2.58 excess deaths in four years, or approximately 0.6 excess deaths per year. It was concluded that infant restraints could thus save three lives in five years. This study was restricted to airline travel and did not take into consideration general aviation aircraft, which make up approximately 90% of the total aviation fleet. This study also dealt with infants and did not consider children over two years.

SEATBELT REGULATIONS RELATED TO INFANTS/CHILDREN

Current FAR operating rules require a seat belt to be used during takeoff and landing, except for a sport parachutist who can sit on the floor, and a child under two years of age, who may be held by a seated adult. Safety belt use is addressed in Part 91.14 (general aviation), Part 121.311 (air carriers), and Part 127.109 (air carrier helicopters), and Part 135.117 (air taxi and commercial operation) (11). Since these are the regulations which allow infants/children to be held without restraint, they are reviewed as follows.

Pertaining to general aviation aircraft operation FAR Part 91.14 (2)(3) states that "...a person who has not reached his second birthday may be held by an adult who is occupying a seat or berth..."

Air carrier operations (Part 121.311(1)) also specifies that "no person may operate an airplane unless there are available during the takeoff, en route flight, and landing (1). An approved seat or berth for each person on board the airplane who has reached his second birthday; and part (b) says that during takeoff and landing "...a person who has not reached his second birthday may be held by an adult who is occupying a seat or berth. A safety belt provided for the occupant of a seat may not be used during takeoff and landing by more than one person who has reached his second birthday" (9). (Note that this allows a mother to put an infant under her seatbelt, a very dangerous practice.)

In the case of scheduled air carrier helicopter operations Part 127.109(b) states that "a person who has not reached his second birthday may be held by an adult who is occupying a seat..." But there is an additional provision that "in the case of children who have reached their second birthday, but not their 12th birthday, a safety belt may be used for two in a single seat in the strength requirements of the seat and safety belt are not exceeded". (This is also not a recommended procedure by safety researchers.)

Under Part 135, air taxi and commercial operation, children are not mentioned except to specify that there be an oral briefing on"use of seat belts" (135.117)(a)(2). (9)

Thus the pertinent regulations of the FAA allow for exceptions "children" or "persons" under age two years.

Sometimes confusion exists in terms of defining an "infant" or "child" (which the regulations noted above have in general circumvented by addressing a "person" under two years.) "Child restraint systems" addressed in Part 571.213 (CFR 49) "means any device except Type I or Type II seat belts, designed for use in a motor vehicle or aircraft to restrain, seat, or position children who weight 50 pounds or less." (S4) (9). (Type I seat belts refer to lap belts only, while Type II belts refer to combination lap-shoulder belts.)

DEVELOPMENT OF INFANT/CHILD RESTRAINT FOR AIRCRAFT USE

There have been a number of tests and evaluation of infant and child restraint systems relative to automotive use, but very few as applied to aircraft. An exception is the excellent study by Chandler and Trout at the FAA Civil AeroMedical Institute who, 14 years ago conducted controlled impacts to simulate aircraft crash conditions, including inverted tests to assess the effect of turbulence (12). They used six typical child restraint systems which has been approved for automobiles but not for aircraft. However, this report was not released until four years later, and the FAA final requirements for children's restraint protection were not issued until 1985. Yet the need in aviation had been recognized by other groups over 25 years earlier.

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

By the late 1950's the Air Transport Cabin Safety Provisions Committee (S-9) of the SAE had identified the need for child restraint on air transport aircraft and formed a subcommittee. The meeting of April 20, 1961 for example, involved a spirited discussion of alternative locations for the "Proposed Restraint Devices and Flotations Device for Children Under Two Years of Age". These include the placing of a "cradle board" restraint on the bulkhead, under the seat, or the back of the seat in front of the occupant, or using a net restraint device. A representative of one airline was preparing design ideas for consideration (13).

Operating independently, by 1960 the SAE Motor Vehicle Seat Belt Committee had formed a Children's Restraint Subcommittee, which included Dr. John Paul Stapp. This committee addressed recommendations for seat belts in automotive vehicles. In June, 1961, this subcommittee considered the desirability of providing different types of restraints and adjustments depending on the age, or more particularly, size or weight of the child. A first draft was circulated September 14, 1961 for infants to 50 lbs., approximately eight months to six years of age (14). This undoubtedly represents the precursor for FMVSS 213 for automobiles.

Similarly, the SAE S-9 Air Transport Safety Committee published in 1967, after several years of discussion, Aeronautical Recommended Practice (ARP-766 "Restraint Device for Small Children"). A simple-one-page of general recommendations, it was extensively revised in October, 1976 (766A) (15), and is presently being further updated. In 1976 the SA published a second ARP 1469 "Restraint Device for Infants". This ARP established guidelines for the performance of infant restraint systems used in civil transport aircraft, for recumbent position infants weighing up to 20 lbs. (9.1 KG) (16).

CIVIL AEROMEDICAL INSTITUTE (CAMI), FAA

A research study to analyze the need for infant and child restraint (primarily in air carrier aircraft) and conduct dynamic testing was proposed in 1961 by John Swearingen at the FAA's Civil Aeromedical Research Institute (CARI) (now Civil Aeromedical Institute, (CAMI), of Flight Standards Service's Office of Aviation Medicine (OAM). However, it was not given high priority and no funding or project assignment was made by OAM.

The same fate met a proposed USAF study of child restraint for military transports which was cancelled without funding in 1961.

In 1964 an infant dummy (Mark I) was designed and fabricated by Swearingen and Young at CAMI for use int he crash test of a DC-7 in 1964 (17). This was relatively crude, and in 1974, an improved Mark II CAMI Infant Dummy was constructed by Chandler (18).

As soon as child and infant restraints became available for automotive use, a number of problems resulted. Parents attempted to take them on board air carriers. The airlines responded in various ways since there was a complete lack of standards or even guidelines from the FAA.In general airlines did not allow parents to use child or infant restraints during takeoff or landing. The author many times overhead flight attendant's explain that "it is an FAA requirement that the parent hold the child in the lap." (As noted in Part 121.14 (a)(2) that is inaccurate, as well as dangerous, although normal airline procedure is for the parent to hold the younger child on the lap.)

In the 1960's and 1970's this three-way conflict between the FAA, the air carriers, and the parents created confusion which still is evident. Parents attempting to bring infant or child restraints aboard air carriers assumed that those certified as meeting the impact protection requirements of FMVSS 213 would offer protection in aircraft as well as the automotive vehicles they were designed for. (Currently some airlines such as Delta, have the ability through a computer print-out containing both rules and listings of all approved child/infant restraints to advise parents at the ticket counter or at the gate.)

Unfortunately, there are a number of differences between the aircraft impact environment and that of automobiles which affects the quality of protection an automotive child or infant restraint may offer in an aircraft deceleration. For example, most general aviation aircraft do not have seat-back locks, and air carriers have a breakaway feature, thus the seat back itself may come forward. Some automotive child restraints require over-the-seat or upper attachment to prevent the top from swinging forward. This feature is not present or ineffective in aircraft. Turbulence can cause a child to slip underneath or be thrown about in a standard car restraint. Also, aircraft seat cushions generally differ from automotive and this influences response. Differences between survivable automotive and aircraft crash impacts include the multi-directional aspects, with aircraft commonly having a high vertical component as well as a longer duration and lower forces, in contrast to many automotive impacts.

Recognizing that it was necessary to conduct tests using aircraft seats in typical aircraft crash profiles to determine how effective seats developed for automobiles may be in aircraft crash environments, Chandler conducted a series of tests at CAMI in 1974, published in 1978 (12.

On February 6, 1974, the FAA received a petition (S.R. Miller) to revise Part 91, subpart A91.14 in the public interest. The recommended revisions were:

"1. All children who have reached the age of one year old or who weigh 20 lbs. or more and have not reached their 4th birthday, shall be required to be seated in their own seat, belted in a certified children's safety seat on takeoff and landings, and/or at such time that the pilot in command so deems necessary.

2. Those persons under one year old and who weigh less than 20 lbs. shall be required to have his or her own seat and be securely belted in a certified safety seat for their size."

These rules shall apply to all U.S. Certified Civil Aircraft.

No adult may hand hold a child during the aforementioned time. It shall further be expressly prohibited for the practices of two persons, regardless of age, doubling up under one seatbelt. The use of a bassinet type berth should no longer be permitted during takeoffs and landings. These safety seats should be located in such a manner as not to interfere with the egress of other passengers in the event of an emergency (19).

On April 2, 1976, the FAA replied requesting that he withdraw his petition "in order that the Agency may avoid delay", since in view of the CAMI tests the "Agency is finalizing design and strength requirements for these devices" (20).

In 1974, FAA comments on the proposed SA ARP 766A for small children issued by SA in 1967 and proposed by ARP 1469 for infants, was followed by a draft discussion paper by Chandler (June 11, 1974). In response to a request from AFS-424 to the Federal Air Surgeon, a project was initiated to test and approve infant and child restraint systems for use in civil aircraft. This included a review of the state-of-the-art with a critique of the 1967 Aeronautical Recommended Practice (SA), FMVSS 213 (effective April 1, 1971), proposed revisions (Docket 76-9, February, 1974), and Parts 91.14, 121,311, and 127.109 of the Federal Aviation Regulations. This study by Chandler at CAMI represented the most complete analysis available to that date (21). It was concluded that NHTSA rulemaking regarding FMVSS 213 was pertinent to any FAA rulemaking activity, but while awaiting NHTSA decisions FAA should make "preliminary efforts" to reestablish the additional environmental conditions which might be required in aircraft. If the NHTSA decision in final rulemaking was delayed it was recommended that "interim certification of infant or child restraint systems could be provided by subjecting them to a test procedure..." (21).

The 1974 state-of-the-art analysis (21) was followed by a test program by Chandler evaluating six models of child and four models of infant restraints approved for automotive use under FMVSS 213 (13). A test specification was provided which detailed dynamic test conditions. Since an aircraft system must provide protection during takeoff and landing, turbulent flight conditions, and survivable crashes, some conditions (such as seat characteristics, crash impact pulses) were found to differ from that needed to protect children and infants in automobile crashes. Various problems were pointed out when restraint systems intended for automobiles were tested in aircraft impact simulation. The results of the 1974-1975 CAMI studies were not published until March 1978 (12).

In February, 1979, a FAA Task Force on Child Restraint was established to evaluate child restraint devices used aboard aircraft and to explore the options for allowing child restraint devices in aircraft. The Task Force recommended to the Administrator that the most suitable approach was to adopt FMVSS No. 213 (Child Restraint Systems), and add additional provisions for the aircraft environment (22).

In 1979, the General Accounting Office examined the FAA's safety effectiveness and recommended a number of changes "to make the FAA able to respond more quickly and effectively to aviation hazards". Child restraints were used to illustrate the "untimely or inadequate" corrective actions to protect against safety hazards. The GAO report (26) concluded:

> "...Child Restraint System. FAA has conducted research on infant/child restraint since the early 1960's. However, as of September 1979, FAA's efforts had failed to produce new requirements. Efforts have centered on developing standards and testing procedures to be used in manufacturing child restraints for use on aircraft. FAA officials told us that allowing use of National Highway Transportation (sic) Safety Administration-approved car seats as an interim measure was not possible because (1) these seats have not been tested for aircraft use and (2) they could cause injury to other passengers during evacuation.
>
> The GAO report noted that the September 1972 FAA research progress report, however, stated that when properly used, two types of auto seats would provide improved crash protection for children sitting in aircraft. The report suggested that the seats be used only at window locations so as not to restrict other passenger evacuation. This effort was similar to FAA's latest approach, which was to use updated National Highway Transportation Safety Administration car seat standards with modest additional FAA requirements. It would appear then that FAA may have been able to be more timely with at least an interim solution to this problem, had it pursued the 1972 research effort more diligently." (26 p. 40).

By October 2, 1980, a draft Technical Standard Order (TSO-C100) was issued for public comment until January 2, 1981 (24,25).

The GAO study found that injuries to unrestrained infants (9) in aircraft prompted the FAA in 1973 to place a "high priority" on development of requirements for suitable restraints. However, the study was cancelled in 1977 because it failed to develop them. Subsequently, another unit began another project that developed requirements, but that project was cancelled and they were not adopted because the unit "wanted to concentrate on higher priority work" (26). After a December, 1978, airline crash in which two infants were killed, the FAA again placed a "high priority" on the restraint problem, and another project, similar to the study in 1973, was started. The GAO concluded that two types of automotive restraints could provide improved crash protection for children in aircraft.

Also of importance informing the requirements were a series of dynamic tests of representative child restraint conducted by Naab at CALSPAN for NHTSA in 1982 (27). These seats met the requirements of FMVSS 213 (30 mph impact) on a simulated aircraft seat at 20 mph and were to determine if additional dynamic testing was needed for aircraft use certification. In these tests, dummies simulating three-year old and nine-month old children were used. Four types of child restraints were tested with six potential injury levels in aircraft seats is below that of comparable auto tests. Aircraft seat back contact was considered non-injurious. Forward head excursions and head injury criteria (HIC) levels were found to be within FMVSS 213 ranges.

May 12, 1982, FAA issued (based on CAMI 1974 tests) TSO C-100 (25). This prescribed the minimum performance standard that child restraint systems must meet. New models of child restraint systems, manufactured on or after this date, must now meet the Federal Motor Vehicle Safety Standard (MVSS) 213 (Child Restraint Systems) which was effective June 1, 1981 (28). Previously child restraint used in aircraft must first pass certification for motor vehicles and then pass four additional performance tests. These included a dynamic impact test at 20 mph for all restraints not equipped with a tether strap; a dynamic impact test at 30 mph for all restraints with a tether strap; and inversion test (to protect from turbulence), held three seconds at 180 degrees; and require that child seats withstand ultimate inertia forces specified in 14CFR 25.61 (air carriers) with each force acting separately.

On August 30, 1984, the final rule was published amending FMVSS 213 to certify for both automobile and aircraft, effective February 25, 1985 (29). NHTSA was now to be the sole agency responsible for administering the combined standard. At this point there were 42 models of child restraints certified for motor vehicles under FMVSS 213 and only five also FAA approved. The TSO-C100 was now cancelled by the FAA, effective March 15, 1985, as specified in TSO-C100a, issued the same date (30). After this date, "no person (including holders of TSO-C100 authorizations) may identify or mark an article with TSO-C100".

On June 1, 1984, the FAA Air Carrier Operations Bulletin provided principal operations inspectors guidance on the new single performance standard for use of child/infant restraint systems in aircraft to bring "to the attention of their assigned certificate holder" (31). Of particular interest is paragraph "c":

"c. A person under the age of two may continue to be held in an adult's lap or placed in a regular passenger seat for takeoff and landing. The FAA does not require but, because of the safety benefits thereof, does encourage the use of approved child/infant seats aboard aircraft.* An air traveler should check with the certificate holder providing the transportation to determine if it will accept an approved seat's use and whether it will require the purchase of a ticket for an approved seat's use" (p. 190). This would indicate that an infant could be placed in an adult seat with or without child/infant restraint; yet an infant restrain only by a lap-belt intended for use by adults is not going to be very well protected.

A "Fact Sheet" issued by the FAA Office of Airworthiness Aircraft Engineering Division on February 25, 1985, provides clarification of the by now confusing status of "Child Restraint Systems Acceptable for Use in Aircraft" (32), and the FAA has issued a leaflet for general distribution (33). It was noted that the FAA has approved 36 different child/infant safety seat models for use in aircraft, but effective February 26, 1985, all child/infant restraint systems will be certified under FMVSS 213. Acceptable systems are now any child/infant seat manufactured between January 1, 1981, and February 25, 1985, bearing the label "This Child Restraint system conforms to all applicable federal motor vehicle safety standards", or any system manufactured after February 26, 1985, that also bears an additional label printed in red "THIS RESTRAINT IS CERTIFIED FOR USE IN MOTOR VEHICLES AND AIRCRAFT". Unacceptable systems were unlabeled child seats manufactured before January 1, 1981, or vest- and harness-type child/infant restraints manufactured before February 26, 1985.

In april 1985, the rules amended the inversion test with more objective test criteria and simplified certification (24).

FEDERAL MOTOR VEHICLE SAFETY STANDARD (FMVSS) 213

The National Highway Traffic Safety Administration established standard No. 213 (Child REstraint Systems) in 1971. NHTSA proposed tougher regulations in 1974 that called for testing child restraints in simulated front, side, and rear crashes, although no action was taken until 1978. Amendments were added in 1979 to both FMVSS 213 and 209 (Seat Belt Assemblies and Anchorages) (44 FR 72131, 12 December 1979), and in May, 1980, NHTSA responded to several petitions for reconsideration, publishing a final rule October 9, 1980 (45 FR 29045). These changes changed labeling requirements to permit the use of surfaces, and extended the effective date of the standard from June 1, 1980 to January 1, 1981. NHTSA FMVSS 213 provisions cover all types of systems to restrain children such as infant carriers, child seats, harnesses, and car beds. More recent requirements replaced static testing with 20 and 30 mph dynamic testing, and prohibits restraints from collapsing during dynamic tests, among other requirements. As noted previously, FMVSS 213 was changed to certify for both aircraft and automobiles, effective February 1985 (29), and subsequently in April, 1985 (34), certification was simplified for manufacturers wishing to certify restraints for both auto and aircraft, and the inversion test was modified.

This briefly summarizes the background and status of FAA regulatory action regarding child and infant restraint.

COST BENEFIT STUDIES

Economic issues seem to be key to mandating child seats from the FAA and airlines point of view. Younger children may fly at reduced fares and those under tow on a lap travel free. The airline loses revenue on every reserved seat not occupied by a full-fare passenger. In 1982, the FAA conducted an economic analysis (35), and assuming a human life value of $530,000 and a fatality rate of three children over a seven-year period whose lives might have been saved through the use of restraint, the savings would be, doubling the mortality rate, approximately one life per year or $500,000. This analysis estimated that 2.8 million infants would occupy seats for which operators might otherwise charge a nominal $20 each. Other costs considered were that of putting two or three child restraints on each of 2,500 commercial aircraft in service at $50 each, resulting in an initial equipment cost of about $250,000 to $375,000, plus yearly expenses of maintenance and handling, at a $56 million annual cost (35). The analysis was interpreted by the FAA that the minimum public costs far outweigh the maximum public benefits (34).

A different point of view was expressed in the 1981 epidemiological analysis conducted at Harvard (10). Their study estimated that three lives of infants could be saved in a five year period. Based on an air carrier fleet of 2500 aircraft (1978 statistics), a ratio of available seat miles to revenue aircraft miles flown gives a mean of 150 seats per aircraft. Fife and his colleagues estimated that four child restraints per aircraft would be sufficient, that a seat has a useful life of five years and costs $30 in bulk, resulting in an expenditure of about $300,000 before any lives were saved. If these lives were saved over five years, a mean time from the $300,000 cost to the saving of life is 2 1/2 years, and the Harvard study added in the interest at 12 percent on this cost to come up with a total cost of approximately $400,000, or $133,000 per life. These authors maintain that saving the life of a baby for $133,000 is "an attractive trade". They further identify in advance, as shown by the airlines willingness to sell reduced rate tickets for certain flights or conditions. By assigning infants to those flights they suggest that the cost of the extra seat occupied by the infant and infant/child restraint can be reduced substantially, and further that some families might be willing to bypass such arrangements and absorb the extra cost.

Another cost analysis, taking issue with the FAA cost, was proposed by the Aviation Consumer Action Project founded by Ralph Nader, in a petition for rulemaking in 1983. They calculate the airlines would have to purchase about 6,786 child seats for a cost of $32.50 each (in bulk), or $222,241, an annual cost over a five-year seat lifetime of $44,448. They conclude the FAA savings was conservative and did not include infant deaths in their own records, and that a yearly cost of $44,448 to save $500,000 was clearly in the public interest (36).

It is difficult to project objectively such studies because of the assumptions used in that analysis and quality of statistical data available. As an example, the accident statistics routinely show that travel by schedule commercial airlines is much safer than travel by automobile, and both are safer than travel by light plane or business aircraft. General aviation travel is almost 10 times as dangerous as automotive travel, and 250 times as dangerous as flying on a scheduled commercial airline, when fatalities per 100 million passenger-miles are used as a basis. However, if the basis is changed to fatalities per 100 million vehicle-miles (ignoring the number of occupants per vehicle) different figures are produced. As calculated by vehicle-mile methods, automotive travel can be shown to be more than twice as safe as scheduled airline travel, and ten times safer than general aviation. Thus the relative safety of travel, as expressed in fatality rate, depends upon how these rates are calculated (37).

The Harvard study (1981), FAA analysis (1982), and ACAP petition (1983) did not consider the larger question of overall saving of life in cost benefits to air transportation in general, but restricted arguments to the question of air carriers which represent only about 2.2 percent (4,904 aircraft) (38), of the total operational fleet (224,953 aircraft) (38), a relatively small segment. THere is the probability that significantly more infant/child lives are lost in general aviation (non-air carrier) operations. If so this would greatly reduce the cost benefit ratios of economic studies. However, in general aviation there is not usually the problem of lost revenue seats. Sparse as the air carrier infant fatality data are, at this time no federal agency appears to have any idea of the extent of the problem (and risk) in general aviation operations. Improved data collection is clearly needed.

INFANT/CHILD RESTRAINT USE IN GENERAL AVIATION

Despite the emphasis on the air carrier, a recent study suggests that general aviation pilots, lacking guidance from the FAA, are going ahead and using child/infant restraint anyhow. In a survey of women pilot members of the Ninety-Nines, the international organization of women pilots, it was found that 39 percent of the 250 pilot responses received carry infants (weighing less than 20 lbs.), in aircraft commercially available automobile child/infant restraints. Yet 33 percent reported no restraint for infants other than "held in arms". Small children of 20-40 lbs. were most often restrained by a lap belt, often combined with an extra seat cushion. This preliminary survey indicated there may be a significant usage of infant/child restraints in general aviation, and this is an area that should be addressed (9).

The author routinely used child restraints in general aviation flights involving family children in the 1960's, and one child used a Ford Tot-Guard child restraint up to age eight years comfortably in light aircraft.

TESTS OF "LAP-CHILDREN"

Although parents on current airline flights are instructed to hold the infant under two years of age on their lap, from an occupant protection viewpoint clasping the child in the mother's or father's arms offers virtually no protection at all in the impact deceleration of a crash, or even in severe turbulence inflight. The child literally is at risk as a free-flying, unrestrained missile.

Tests conducted at the University of Michigan a decade ago explored the ability of male and female adults (who were parents of young children) to restrain lap-held 7.9 kg (17lbs.) dummies (representing six-month old infants) in automobile crashes. Three male and three female healthy young parents (aged 26-34) were belted onto a typical automobile seat in a 3-point lap-shoulder belt, and subjected to various strength, pull test while relaxed and pre-tensed, and dynamic test. At a peak deceleration of 35G the combined inertial force of a 7.9 kg infant and the forearm would be about 2800 N (629 lbs). This value is almost four times greater than any strength value for females and more than twice the higher male strength value. They noted that if the child is older and weighs more, the inertial forces would be correspondingly higher. For a 7.99 kg infant the inertial forces at 10 G's could be in excess of 1000 N (ca 225 lbs.), a limit for many adult females. Sled tests have shown that even at low velocity impact of 25 km/h (15 mph), decelerations can exceed 15 G's. The authors conclude that "...children (under two years old) in airplanes are also being exposed to undue risks of injury by the requirement that they be transported on adult laps" (40, p. 644).

In addition, there is the possibility that the jack-knifing parent (since shoulder harness is not provided) will flex forward and cause crushing injuries to the child. The use of pillows, blankets, and other devices by the airlines may even increase the potential danger of injury to the infant. Another technique, that of placing the infant inside the parents lap belt, is also especially dangerous.

In rare cases, parents have been able to successfully hold the infant, as in the father seated in the last row of the Denver crash, however, this may be due to a combination of unusual factors including much lighter occupant deceleration forces, pre-crash warning and preparation (tucking in the child), and male strength. It is clear that in most crashes, even at low speeds, the child will be at high risk of injury and death.

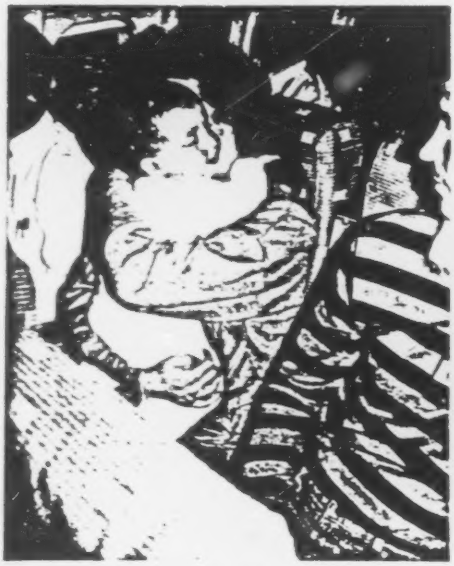


Figure 1. Nine-month old infant held tightly by mother in preparation for take-off.

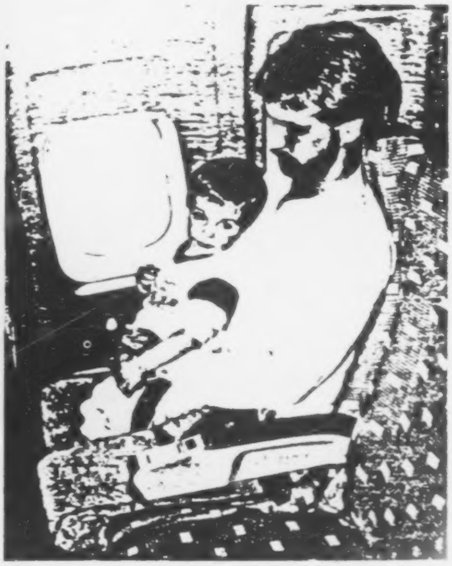


Figure 2. Another lap-held child in a typical take-off or landing position.

CURRENT RESTRAINT SYSTEMS

At present there are over three-dozen infant/child restraint models that have been certified as approved for aircraft use. Most manufacturers rate their restraint systems by size rather than age. In general infant/child restraints are designed for occupant 20 lbs. or under, child restraints 20-40 or 50 lbs., while booster seats may be rated up to about 60 lbs.

There are presently four general classes of infant/child restraints, designed for slightly different child populations.

Infant seats are intended for infants up to 20 lbs. who are not able to sit up by themselves. Infants are generally able to sit up with support by the third or fourth month, and by the seventh month can be expected to sit alone. Infant seats provide best protection installed rearward to allow the best distribution of loading over the body. Usually the infant seat places the occupant in a semi-reclined position inside a padded shell of molded plastic, and the infant restraint can also be used as a carrier. Century, Cosco, Evenflow, and Kolcraft are among the principal manufacturers of infant seats, and costs are generally under $35.

Another type of restraint is called a convertible seat and is designed for infants and toddlers up to 40 lbs. The convertible feature is that after being initially used as a rear-facing semi-reclined device, it can be turned around to face the front as the child gets older and can be converted to an upright position. Such systems have three to five belt attach points, and usually feature a partial or full shield. This type of restraint is becoming more popular as it is more utilitarian.

A third type of restraint is a toddler seat. These restraints do not recline and are rated up to about 40 lbs.

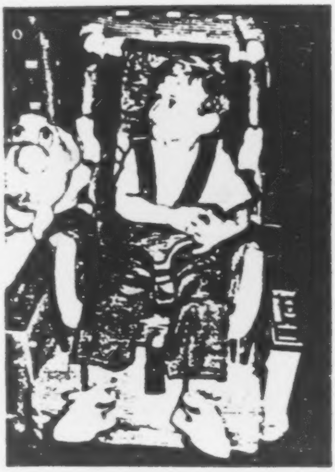


Figure 3. Illustration of a typical 5-point child restraint approved for aircraft as used by a two-year old child

Finally, booster seats provide a means to raise the older child, up to about 60 lbs., higher to provide a better view, and sometimes to take better advantage of the lap belt restraint. Boosters are secured with a lap belt, as are the others, but may also be used with shoulder restraints when available in general aviation aircraft.

The question of what type of restraint should the older child use often comes down to a choice between the adult lap belt or the child restraint device. Most children over two years of age use the adult lap belt, and less frequently a child restraint. Carrying a child restraint aboard, along with other carry-on baggage needed by the parent, can be can be difficult and awkward, especially if the mother is pregnant as well, or traveling alone with child. But, for the younger child, a child restraint device properly installed and adjusted in the adult lap belt, does unquestionably offer the best protection.

While the author had investigated cases of general aviation aircraft accidents where young children (6 or 8 years old) have been uninjured wearing the lap belt alone, some automobile accidents involving young children wearing lap belts have resulted in disabling spinal injuries. In 1975, we examined this issue in regard to automotive lap-shoulder belts with interlock features requiring the user to wear the diagonal shoulder belt (41). While passengers do not yet wear the diagonal shoulder restraint in air carriers, they do in general aviation aircraft and many business aircraft. At that time, injury data for children involved in automotive accidents was limited and inconclusive (and it still is). But it was concluded that specially designed child or infant restraints were the first choice to protect the younger passengers. Lap belts were a second choice, based on the data available, and parental judgement was suggested in regard to fit of the shoulder harness impinged on the neck or face incorrectly (41).

There have not been many useful child restraint articles in the aviation literature to date. A recent (1987) issue of Aviation Safety devoted an entire issue to child seats, particularly in regard to general aviation (42). An early and comprehensive review of child restraint potential for use in general aviation business aircraft was conducted by Business and Commercial Aviation in 1976 (43).

In the mid-1970's, Laker Airways, the British charter operator, recognized that lap-held infants and turbulence, impact, or heavy braking conditions were a dangerous combination. They designed their own infant restraint device, consisting of a length of webbing attached to the mother's seat belt by a loop, forming a separate infant restraint (44).

This system is manufactured by Irvin Great Britain Ltd. as an AB5 series of passenger safety belts, with an extension belt attachment for infants of about 20 inches maximum circumference, which is CAA approved. Such systems are being used or explored by several airlines in England, Germany, Australia and elsewhere, as an attractive way to resolve the extra seat problem and associated cost (as it doesn't require a separate seat), and yet provide infant restraint.

However, until adequate testing of this type of restraint system is conducted, it is not recommended. Biomechanically it does not appear to offer acceptable protection for an infant as the loading would be concentrated on soft tissue and the fragile spine rather than distributed over the body as in approved infant restraints, and the restraint itself could inflict injury in an abrupt deceleration.

The United Kingdom Article 34 of the Air Navigation Order requires that for takeoff, landing, turbulence, or emergency conditions "all passengers are properly secure in their seats by safety belts or harnesses". At present UK Flight Manuals require a separate seat only for children of age three years or older. In 1986, the Civil Aviation Authority proposed that the Order be amended "to require explicitly that all infants below two years of age be secured by an approved restraint device in the circumstances where other passengers are required to be secured in their seats" (45). Among the devices being considered, is a supplementary loop belt attached to the seat belt, as noted above.

In Australia, the use of child restraints approved for automotive use is acceptable for use in general aviation if it is manufactured to comply with Australian Standard AS 1754, and secured to the aircraft seat or structure in such a way to resist inertia forces of 9 G forward, 3 G upwards, and 1.5 G sideways. The Standards Association of Australia keep available in each capitol city a currently approved list of child restraints.

Internationally, few countries besides the U.S. Federal Air Regulations actually specify that infants or children are allowed to be lap-held, restrained only by an adult's arm.

PREGNANT WOMEN

Pregnant women passengers now routinely travel by air well into the last trimester (and this question regarding pregnant flight attendants has become an issue in the past). It is important that these women wear the lap belt low and snug on landing, takeoff, and in turbulence especially. Sometimes women place the belt high up on the abdomen for comfort, but this can be extremely hazardous on impact. Over two decades ago we conducted tests with pregnant baboons on the Daisy decelerator at Holloman AFB, New Mexico, in tests conducted by the FAA to determine the effect of impact on the fetus (46). It was concluded that the fetus is in a well-protected environment and that the critical factor was the survivability of the mother. This could be improved by wearing the lap belt correctly, so the load is distributed under the bony pelvis, rather than the unprotected, soft abdominal area.

INFANT/CHILD ANATOMY, BIOMECHANICS, AND HUMAN TOLERANCE

The proper design of infant/child restraints must take into consideration the physical construction of its tiny and fragile occupant. A child's body dimensions, proportions, and biomechanical properties are so markedly different from that of an adult, that a child cannot be considered as simply a scaled-down miniature adult. In order to assist the engineer in proper child restraint design from a pediatric, anatomical, growth and

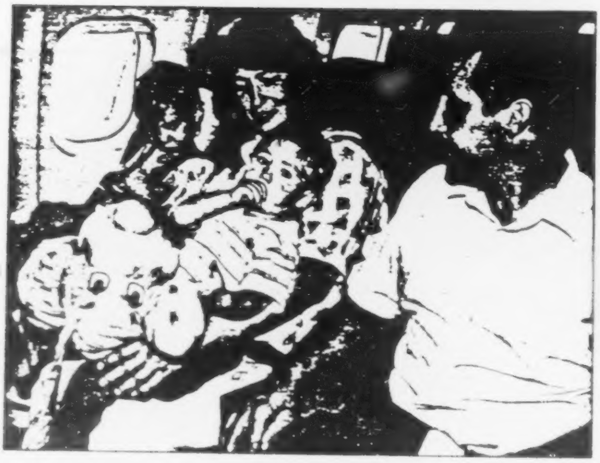


Figure 4. This family of "five" is occupying three seats. The four-year old child in the window seat is in an approved child restraint. His mother, nine months pregnant, (she delivered a daughter a few days later), is wearing the lap belt low and comfortably snug, but is lap-holding her two-year old child and his friend.

development, and anthropometry point of view, a study was conducted to emphasize key factors. Problems discussed include child-adult structural differences, center of gravity of the body, head mass in relation to neck and general body proportions, positions of key organs, and biomechanical properties of tissues (47). Designers should be aware of these differences between the adult and child.

Little is known about human tolerance of the child as compared to the adult male, which has been the model of most studies (6). Some data have been derived from free-fall impacts of children, and while children are more fragile, they can absorb head impacts apparently in excess of that of the adult due to the undeveloped bony structure of the skull and flexible tissues (48). Yet, the comparatively large head mass perched on fragile neck structure, is significantly different from the adult. Head impact in children, followed by thoracic injuries, are the major cause of impact fatalities and serious injuries.

SUMMARY

The foregoing discussion has been intended to provide an overview of infant/child restraint protection in aircraft, and identify some areas for further workshop discussion in this conference.

Some general, as well as specific conclusions can be drawn.

*Equal protection is not provided to all aircraft passengers. The discrepancy can be illustrated by comparing the relative protection afforded a typical flight attendant (seated in a rear-facing seat, against a bulkhead, next to an exit, secured by a 4-point double shoulder harness and lap belt with inertial reel system), with the lap-held infant lacking any restraint at all. The infant/child population is at much greater risk when exposed to a crash impact (as well as decompression, turbulence, emergency egress, or ditching). Infants and children have been called the neglected airline population.

*A greater effort should be made by the responsible federal agencies to collect and analyze infant and child accident experience, with and without restraints, and especially focus on general aviation. At present a statistically significant basis for analyzing air carrier accidents is very marginal, since non-revenue infants may not be counted or accident investigation not obtained needed data. A data base for general aviation is non-existent.

*The evolution of FAA standards for infant/child restraint has been unreasonably slow and behind the state-of-the-art as compared to automotive transportation. The current certification of restraints for aircraft use provides a reasonable basis for markedly improving infant/child protection, but unless such devices are available and used (correctly), the lap-held infant remains virtually unprotected, and the young child wearing a lap belt designed for adults, may be inadequately protected.

*A lap-held child must be considered as an unrestrained flying missile in the event of a crash impact. Tests have shown that even low-level inertial forces may be beyond the physical limits of the parent to hold the child. A lap-held child is at risk in an impact with the seat back, bulkhead or forward structures, or crushing as the parent is jack-knifed over the infant. Some hazardous techniques (infant placed under parent's lap belt, use of two children in a single belt, use of pillows) should be eliminated through education.

*The only valid protection currently available to the infant/child in aircraft is the use of an approved (FMVSS 213) seat which the parent presently must bring aboard and adjust.

*Greater use of child restraints should be actively encouraged, and the airlines should give priority to working out better solutions, including seat availability, management techniques and providing restraints. Unless the parent purchases a ticket for the extra seat (for under age two child), there may not be a seat to use a child restraint. The FAA should become more serious about the use of child restraints and insure that every child has the opportunity to be protected with a child restraint. The FAA has given almost full attention in the past to the airlines economic issue, and should encourage vigorously and mandate, infant/child restraint in general aviation as well as air carriers.

*It is concluded that infants and children under two years represent a large, neglected population, both in terms of meaningful FAA regulations and risk of death and injury.

REFERENCES CITED

1. Grimm, A.C., "International Restraint Use Laws," UMTRI Research Review, The University of Michigan, 18(4):1-9, 1988.

2. National Safety Council, Accident Facts, 1987 Edition, Chicago, pp 2:84, 1988.

3. Bureau of the Census, National Data Bank Guide to Sources, Statistical Abstract of the United States, 1988, 108th Edition, U.S. Department of Commerce, Washington, D.C., 1987.

4. Federal Register 43(97):21471, National Highway Traffic Safety Administration, "Child Restraint Systems: Seat Belt Assemblies and Anchorages," Proposed Rulemaking, Docket No. 74-9; Notice 04, May 18, 1978.

5. Department of the Air Force, Accident/Incident Report C5A, Saigon, Viet Nam, April 1975.

6. Synder, R.G., "Impact Tolerance of Children," Proceedings, Seminars on the Etiology, Pathologies and Clinical Findings in 34 Children Involved in the 1975 Viet Nam C5A Transport Crash, March 1979.

7. National Transportation Safety Board, Human Factors Report, United Airlines McDonnell Douglas DC-8-61 Accident, Portland, Oregon, 28 December, 1979, 1980.

8. Marshall, N.C., Survival Factors Group Chairman's Factual Report. National Transportation Safety Board, Bureau of Technology, Accident Stapleton International Airport, Denver, Colorado. November 15, 1987, 1416 MST Continental Airlines, Inc., McDonnell Douglas DC-9-14, N626TX. Washington, D.C. Docket No. SA-469, Exhibit No. 6-A, 1988.

9. Marshall, N.C., National Transportation Safety Board, Survival Factors Specialist Report, Eastern Airlines Airbus 300, Atlantic Ocean, 5/28/85 approximately 1315 AST, Washington, D.C., 1985.

10. Fife, D. B. Rosner, W. McKibben, "Relative Mortality of Unbelted Infant Passengers and Belted Non-Infant Passengers in Air Accident with Survivors," AJPH, 71(11):1242-1246, November 1981.

11. Code of Federal Regulations, Aeronautics and Space, 14, Parts 1 to 59, Parts 60 to 199. Revised as of January 1, 1988.

12. Chandler, R.F. and E.M. Trout, Child Restraint Systems for Civil Aircraft, Civil Aeronautical Institute, FAA, Oklahoma City, FAA-AM-78-12, March 1978.

13. Society of Automotive Engineers, Inc., SAE 5-9, Air Transport Cabin Safety Provisions Committee, Minutes and Notes of Meeting April 20, 1961.

14. Society of Automotive Engineers, Inc., Restraining Devices for Children (8 months to 6 years) for Use in Motor Vehicles, SAE J—. Proposed SAE Recommended Practice, Report of Motor Vehicles Seat Belt Committee Draft, November 7, 1961.

15. Society of Automotive Engineers, Inc., Aerospace Recommended Practice (ARP 766) Restraining Device for Small Children, Issued 30 September 1967, Revised (ARP 766A) 15 October 1978.

16. Society of Automotive Engineers, Inc. Aerospace Recommended Practice (ARP 1469), Restraint Device for Infants, Issued October 1978.

17. Reed, W.H., S.H. Robertson, L.W.T. Weinberger, and L.H. Tyndall, Full-Scale Dynamic Crash Test of a Douglas Dc-7 Aircraft, Aviation Safety Engineering and Research Flight Safety Foundation Inc., Phoenix Prepared for Federal Aviation Agency, FAD TEchnical Dept., ADS-37.

18. Chandler, R.F., Construction of an Infant Dummy (Mark II) for Dynamic Tests of Crash Restraint Systems, Federal Aviation Administration, Civil Aeronautical Institute, Oklahoma City, Memo Department, AAC-119-74-14, March 27, 1974.

19. Miller, S., Letter to FAA Administrator Butterfield, February 6, 1974.

20. Pensall, A.R., Letter to S. Miller from Chief, FAA-FSS Air Carrier Regulation Branch.

21. Chandler, R.F., State-of-the-Art: Rulemaking in Infant and Child Restraint Systems for Aircraft Crash Protection, Federal Aviation Administration, Civil Aeronautical Institute, Oklahoma City, Memo Department, No. AAC-119-74-18, August 26, 1974.

22. Task Force on Child Restraint Systems, Technical Review Group Effort, February 21, 1979.

23. Federal Aviation Administration Advisory Circular, Use of Child/Infant Seats in Aircraft, AC No. 91-62. 26 February, 1985.

24. Federal Registry, Notice 45(193):65380, October 2, 1980.

25. Federal Aviation Administration, Technical Standard Order (TSO), TS-C100, Child Restraint Systems.

26. General Accounting Office, "How to Deal with the Federal Aviation Administration's Ability to Deal with Safety Hazards", GAO Report CED-80-66, February 29, 1980.

27. Naab, K.N., Performance Evaluation of Child Restraint Systems, CALSPAN Corp., National Highway Traffic Safety Administration Report DOT HS-806-413, October 1982.

28. Federal Register, 49 CFR 571.213080; 44 FR 72131 and 721476, effective date: June 1, 1981.

29. Federal Motor Vehicle Safety Standard, No. 213, Child Restraint Systems, Department of Transportation, National Highway Traffic Safety Administration, 49 CFR, Part 571, Final Rule, Federal Register, 50(162):53722-726, August 21, 1985. (Effective date: February 26, 1985)

30. Federal Aviation Administration, Technical Standard Order TSO-C100a, Child Restraint Systems, dated March 15, 1985.

31. Federal Aviation Administration, "Use of Child/Infant Restraint Systems in Aircraft, "Air Carrier Operations Bulletin No. 8-76-48", 8430.17, Change 36, Chapter 9, paragraph 949, page 940, June 1, 1984.

32. Federal Aviation Administration "Child Restraint Systems Acceptable for Use in Aircraft", Office of Airworthiness, Aircraft Engineering Division, Fact Sheet, February 25, 1985.

33. Federal Aviation Administration, "Child/Infant Safety Seats Acceptable for Use in Aircraft", Community Consumer Liaison Division, Washington, D.C., 1985.

34. Federal Register, 50(74) 15154, April 1985.

35. Federal Aviation Administration, "Cost/Benefit Factors Regarding Child Restraint Seats", Memorandum, June 10, 1982.

36. Petition for Child Restraints Aboard Commercial Aircraft by Aviation Consumer Action Project before the Federal Aviation Administration, Washington, D.C., Docket 23833, 1983.

37. Snyder, R.G., "Survival in Airplane Crashes", The VMTRI Research Review, The University of Michigan, 13(3-4):1-11, 1983.

38. AOPA 1983 Aviation Fact Card, Aircraft Owners and Pilots Association, Frederick, MD (1986 data), 1988.

39. Foley, M.F., and R.G. Snyder, "A Survey of Women Pilots and Child Restraint Use", Unpublished study, 1980.

40. Mohan, D. and L.W. Schneider, An Evaluation of Adult Clasping Strength for Restraining Lap-Held Infants, Highway Safety Research Institute, The University of Michigan, Study conducted for Insurance Institute for Highway Safety, Washington, D.C., September, 1978.

41. Snyder, R.G. and B. O'Neill, "Are 1974-1975 Seat Belts Hazardous to Children?", American Journal of Diseases in Children, 129:946-949, 1975.

42. Uhlemann, K., "Child Seats in Aircraft Saves Lives," Aviation Safety, VII(15):1-7, 1987.

43. Day, N., "Child Restraint Systems," Business and Commercial Aviation, pp 60-63, June, 1976.

44. Personal Communication from J.A.C. Horsfall, University of Cambridge, 8 December 1986.

45. Civil Aviation Authority, Proposal to Amend the Air Navigation Order-Security of Children under 3 Years of Age. Amend Article 34(2)(3)(i), and add (c), London, May 30, 1986.

46. Crosby, W.M., R.G. Snyder, P. Hansen, C.C. Snow, and G.T. Price, "Impact Injuries in the Pregnant Female: I. Experimental Studies," American Journal of Gynecology, 101(1):100-110, 1967.

47. Burdi, A.R., D.F. Huelke, R.G. Snyder, and G.H. Lowrey, "Infants and Children in the Adult World of Automobile Safety Design: Pediatrics and Anatomical Considerations In Design of Child Restraint," Journal of Biomechanics, 2(3):267-280, 1970.

48. Mohan, D.B.M. Bowman, R.G. Snyder, and D.R. Foust, "A Biomechanical Analysis of Head Impact Injuries to Children," Journal of Biomechanical Engineering, 101(4):250-260. November, 1979.

Richard G. Snyder, Ph.D.
President
BioDynamics International

BioDynamics International is engaged in biomedical and aviation safety research and consultation. Doctor Snyder completed his premedical studies at Amherst College and performed graduate work at Cornell University and the University of Arizona. He received his B.A., M.A., and Ph.D. degrees in Physical Anthropology from the University of Arizona.

A commercial, military, and FAA research test pilot, Dr. Snyder has 44 years flight experience in over 70 aircraft models, including multi-engine, sea-planes, helicopters, jet and prop fighters. he flew 100 combat missions in Korea, receiving the D.F.C. and three Air Medals. He has authored over 400 scientific publications, reports and presentations on safety, impact trauma, and biomedical areas of aviation and aerospace medicine. Dr. Snyder is a Fellow of the Aerospace Medical Association, American Academy of Forensic Sciences, American Association for the Advancement of Science, the American Anthropological Association, and the Explorers Club. An Associate Fellow of the American Institute of Aeronautics and Astronautics, he is a member of numerous other aviation, medical, and scientific biological societies.

Designated a distinguished scientist by the University of Michigan Board of Regents in December, 1985, Dr. Snyder was appointed Professor Emeritus of Anthropology. He organized and served as first Director, NASA Center of Excellence in Man-Systems Research, at the University of Michigan, and served as Head, Biomedical Department and as Research Scientist, University of Michigan Transportation Research Institute of the Institute of Science and Technology for 17 years. Prior experience also includes work with Ford Motor Company, the FAA and various academic institutions. Dr. Snyder has been recognized for his contributions to aviation safety with various aviation and aerospace awards.

Aerospace Medical Association

90-1

President
ROYCE MOSER, JR., M.D.
Univ. of Utah School of Medicine
50 North Medical Drive
Salt Lake City, UT 84132

President-Elect
SARAH A. NUNNELEY, M.D.
USAFSAM/VNC
Brooks AFB, TX 78235

320 South Henry Street
Alexandria, VA 22314-3524

703-739-2240

First Vice President
MICHAEL A. BERRY, M.D.
10777 Westheimer
Suite 935
Houston, TX 77042

Executive Vice President
Secretary-Treasurer
RUFUS R. HESSBERG, M.D.
Association Headquarters

RESOLUTION

AIRCRAFT INFANT PASSENGER RESTRAINT

WHEREAS: The Aerospace Medical Association is a 4400 member national organization which has as one of its purposes the promotion of health and safety in flight; and

WHEREAS: Infants and children comprise a substantial segment of the passenger population; and

WHEREAS: Federal Air Regulations presently allow infants and children to be lap-held, thus equal protection is not provided to all passengers; and

WHEREAS: Research has shown that a lap-held child remains virtually unprotected and at much greater risk when exposed to a crash impact, decompression, turbulence or emergency ditching; and

WHEREAS: The only effective restraint protection currently available to infants and children in aircraft is the use of an approved (FMVSS 213) infant/child restraint;

THEREFORE BE IT RESOLVED: That the Aerospace Medical Association at its 61st Annual Business Meeting at New Orleans, Louisiana, on May 15, 1990, strongly supports the required use of approved impact child restraints in modern aircraft.

○